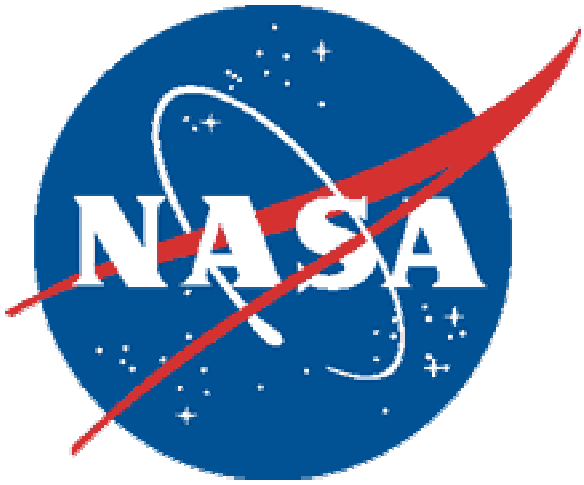

National Aeronautics and Space Administration

Jan. 28, 2003

NRA-03-OES-01

RESEARCH ANNOUNCEMENT

NPP SCIENCE TEAM FOR CLIMATE DATA RECORDS

Proposals Due March 31, 2003

OMB Approval No. 2700-0087

NPP SCIENCE TEAM FOR CLIMATE DATA RECORDS

NASA Research Announcement
Soliciting Research Proposals
for
Period Ending
March 31, 2003

NRA 03-OES-01
Issued Jan. 28, 2003

Office of Earth Science
National Aeronautics and Space Administration
Washington, DC 20546

NASA RESEARCH ANNOUNCEMENT

NPP SCIENCE TEAM

FOR CLIMATE DATA RECORDS

Introduction:

The National Aeronautics and Space Administration (NASA) announces the solicitation of proposals for researchers to participate in a science team organized to assist in the creation of Climate Data Records (CDR) for the planned National Polar Orbiting Operational Environmental Satellite System Preparatory Project (NPP) satellite mission. Proposals should support research efforts that will enable scientists to understand the detailed operations of the environmental sensors to fly aboard the NPP satellite and to evaluate the accuracy with which the operational algorithms provided by the instrument contractors can extend the time series of environmental records begun with NASA's Earth Observing System (EOS) to assure the usefulness of the results to be provided for climate research.

NASA Vision and Mission:

The NASA vision is:
To improve life here
To extend life to there
To find life beyond

The NASA mission is:
To understand and protect our home planet
To explore the Universe and search for life
To inspire the next generation of explorers

...as only NASA can.

Earth Science Enterprise:

ESE is one of five NASA Enterprises seeking to fulfill the agency's vision and carry out its mission. To understand our home planet and to protect it requires scientific knowledge of how the Earth is changing and the consequences of these changes for life. The mission of ESE is to develop a scientific understanding of the Earth system and its responses to changes, as well as to improve prediction capabilities for climate, weather, air quality and natural hazards. The Earth Science Research Program aims to gain deeper insight by describing how the components of the Earth system function, how they interact, and how they may evolve in the future. These interactions occur on a continuum of spatial and temporal scales ranging from short-term weather to long-term climate variations, and from local and regional to global scales. The challenge is to develop the ability to predict changes that will occur in the next decade to century, both naturally and in response to human activities.

In general, the Enterprise aims to provide scientific answers to five challenging scientific and sociatally important Earth system science questions:

- **Earth's natural variability**: How is the global Earth system changing?
- **Forcing factors**: What are the primary forcings of the Earth system?
- **Response to disturbances**: How does the Earth system respond to natural and human-induced changes?
- **Consequences**: What are the consequences of change in the Earth system for human civilization?
- **Prediction**: How well can we predict changes in the Earth system that will take place in the future?

The United States is transitioning from using the Earth Observing System (EOS) for research measurements from satellites and the Polar-Orbiting Operational Satellites (POES) and the Defense Meteorological Satellite Program (DMSP) for weather observations to a joint-agency system of operational environmental satellites. This new system, the National Polar-Orbiting Operational Environmental Satellite System (NPOESS), is being developed and operated by the three-agency (NASA, NOAA and DoD) Integrated Program Office (IPO). NASA's role in the NPOESS is to provide technology insertion. In the future, NASA is depending upon this system to continue the quantitative environmental satellite measurements that began with EOS. These are necessary to assess whether or not the Earth system is changing beyond the normal bounds of its natural variability in ways that represent significant changes that might affect life on Earth.

The experience within NASA concerning climate-quality observations is that detailed characterization of satellite sensors must be made during development and testing, and that frequent calibration during each mission is required to match one satellite's observations to the preceeding ones in order to avoid measurement degradations that are indistinguishable from climatic trends.

It is essential for scientists to understand the detailed operations of these new environmental satellite sensors and to evaluate the accuracy with which the operational algorithms can extend the time series of environmental records begun with EOS. NASA is uniquely positioned to define satellite climatic data records that will merge the data from NASA EOS missions through the NPP to NPOESS.

Description of the NPP Mission and Sensors:

The NPOESS Preparatory Project (NPP) mission has two goals:

- To provide NASA with continuation of global change observations after EOS Terra and Aqua
- To provide NPOESS with risk reduction demonstration and validation of critical NPOESS sensors, their algorithms and their processing strategies.

At least four sensors will be flown on the NPP mission: the Visible Infrared Imaging Radiometer Suite (VIIRS), the Cross-track Infrared Sounder (CrIS), the Advanced Technology Microwave Sounder (ATMS), and the Ozone Mapping and Profiler Suite (OMPS). There is a possibility that a fifth sensor, the Clouds and the Earth's Radiant Energy System (CERES), may be added based on the technical feasibility, risk, schedule, and cost associated with its accomodation. The NPP

mission is a joint activity of NASA and the IPO.

A listing of NPOESS requirements pertaining to NPP sensors may be found in Appendix A of this NRA. The derived products from NPP will include: sea-surface temperature, vegetation index, ocean color, imagery, atmospheric temperature and moisture profiles, aerosol optical thickness and particle size, surface albedo, land surface temperature, ice surface temperature, surface heat flux, cloud top temperature, pressure and height, surface wetness, active fire detection, sea ice characterization, snow cover, suspended matter, and surface type. (The complete list of NPOESS requirements may be obtained from their library on the Internet at:

http://npoesslib.ipo.noaa.gov/Req_Docs.htm

The NPP mission is planned for launch in the 2007 time frame. It will have an 824km polar, sun-synchronous orbit with a 10:30am descending node. All data is to be down-linked to a polar ground station once per orbit and relayed though the Tracking and Data Relay Satellite System (TDRSS). There will also be continuous direct broadcast of all data on X-band. A description of the mission may be found at:

http://jointmission.gsfc.nasa.gov

The VIIRS instrument is a 22-band, multi-spectral scanning radiometer with a 3000 km swath width. Some bands have dual gains. It derives its heritage from AVHRR, OLS, MODIS, and SeaWIFS. There are both imagery and moderate resolution bands with effective pixel sizes of 370m and 740m at nadir. For further information see:

http://www.ipo.noaa.gov/viirs.html

The CrIS instrument is a Michaelson interferometer with 1142 channels in 3 spectral bands with a swath width of 2300 km. Its heritage is the HIRS, AIRS, and the IASI. It will produce daily global sets of high-resolution temperature and moisture profiles for scenes with <50% cloud cover. It is co-registered with the ATMS and is designed to work in conjunction with it. For further information see:

http://www.ipo.noaa.gov/cris.html

The ATMS instrument is a 22-channel passive microwave radiometer with a swath width of 2300 km. Its heritage is the AMSU A1/A2 and the HSB. It provides the initial estimate of temperature and moisture profiles for input to an infrared algorithm as well as an all-weather set of profiles. For additional information see:

http://www.ipo.noaa.gov/atms.html

The Ozone Mapping and Profiler Suite (OMPS), which measures solar scattered radiation to map the vertical and horizontal distribution of ozone in the Earth's atmosphere using a nadir UV sensor and limb-scanning UV/VIS sensors. For further information see:

http://www.ipo.noaa.gov/omps.html

The NPOESS data products are known as Environmental Data Records (EDRs). It is NASA's intent to assure that these EDRs are also suitable for long-term climate studies. Following the nomenclature of the National Academy of Sciences ("Ensuring the Climate Record from the NPP and NPOESS Meteorological Satellites", Committee on Earth Studies of Space Studies Board, National Academy of Sciences, 2000 (http://www.nas.edu/ssb/cdmenu.htm), we call these climate products Climate Data Records (CDRs).

During NPP, the IPO, working through a private-sector systems contractor and affiliated sensor/algorithm contractors, will produce prototype EDRs. NASA will work with the IPO and its system contractor to produce CDRs, either through algorithm enhancements or post-processing, if required. It is the goal of NPP to have all EDRs of CDR quality and stability by the end of the mission. This would enable all future CDRs to be produced directly by the operational system. The overall intent is to ensure that the record of climate-quality CDRs for systematic measurements is continued beyond the EOS era.

Purpose of this NASA Research Announcement (NRA):

This NASA Research Announcement (NRA) provides an opportunity for members of the science community to participate in an assessment of planned EDRs and their adequacy as equivalent CDRs. Some key measurement series initiated with the Earth Observing System's Terra and Aqua missions will be continued by the satellites and sensors of the NPOESS. NPP provides a "bridge" between the EOS Terra and Aqua missions and the NPOESS first operational satellite, currently with its initial launch in the 2009 timeframe.

This initial NRA will support a small team to perform the work described below within a 36-month period. It is anticipated that it will be followed by a second solicitation to select investigators to participate in the NPP data analysis, synthesis, and utilization for research and applications development purposes.

The NPP Science Team will include a number of experts familiar with the development of algorithms to retrieve Earth system properties from sensors such as VIIRS, CrIS, ATMS, and OMPS to study global climate change. Expertise in both sensors and algorithms is needed. The team also will incorporate data system experts and persons concerned with assimilation of these data into Earth system prediction models. The team size and funding level depend on the range of activities proposed that are essential in assessment of planned EDRs and their potential to create CDRs. For example, a proposal may address a single EDR or related sets of EDRs. It may link sensor physics and the EDRs, or data systems and EDRs, or link all three. In addition to the principal investigator, proposals may include the participation of one or more co-investigators with specific expertise whose involvement is necessary for the successful completion of the proposed task. In addition, teaming arrangements that link together the work of several investigators through coordinated proposals are permitted, providing the linkages are explicit and the division of responsibilities, including stand-alone work, is clear.

The efforts of this small team will be focused on determining the adequacy of the provided EDRs for climate change studies. Those EDRs found to be adequate will be produced in the NPOESS operational data system and stored in NOAA's Long-Term Archive. Those EDRs

thought to be inadequate for climate change studies will be studied in terms of algorithm enhancement, adding ancillary data necessary to achieve the needed accuracies, or enabling more-accurate processing steps or other steps necessary to reach the CDR level as proposed by the respondents to this announcement. Once the necessary algorithm enhancements and/or processing changes have been identified, the process will be documented, and initial test data sets generated for intercomparisons with past data sets of similar variables. The focus of this solicitation is EDR assessment and the identification of needed improvements, if any. The algorithm improvements for CDRs and associated enhanced product generation, data analysis, and utilization, if necessary, will be the focus of a follow-on solicitation. Some of the derived CDR data sets may be stored temporarily in the NASA data archive and distribution system for NPP Science Team use, but all CDRs will be provided to the NOAA Long-Term Archive (LTA) for distribution to the entire user community.

Activities of the NPP Science Team Members

NPP Science Team members will be expected to:

- Participate in about 4 technical interchange meetings and science team meetings per year at the NPOESS system contractor's site, sensor vendor's sites or NASA GSFC
- Review sensor and algorithm documents, algorithm code and system descriptions as appropriate
- Conduct data simulation studies as appropriate
- Prepare an algorithm analysis report and recommend algorithm improvement activities
- Participate in the preparation of a science operations concept document
- Support the further development of the NPP Calibration-Validation Plan
- Provide information to NASA on a variety of technical matters associated with NPP instruments and algorithms.

It is expected that the participation at all meetings and reviews will be conducted by the team member or a named co-investigator.

Review of algorithms, that have been written by the NPOESS algorithm development contractors and delivered to NPOESS, will be through analysis of their Algorithm Theoretical Basis Documents (ATBDs) and delivered science code. NASA is establishing a simulation system capable of running the vendor-provided code using MODIS and AIRS/AMSU/HSB data, as well as synthetic data test scenes. Science Team members may utilize this simulation system or their own facilities as appropriate. The results of these analyses will be published in a report documenting the suitability of the operational products as Climate Data Records and the requirements for such additional algorithmic work as may be required. The team will also evaluate the provided sensor characterization data to assess its influence on the employed algorithms.

The science team will also work with the NPP staff to prepare a science operations concept document that defines the way in which CDRs will be produced, validated, stored and distributed during the NPP mission. This document will address interactions with the NPOESS system contractor to facilitate sensor characterization, data access and retrieval, validation, and algorithm migration. It will define interactions with the NPOESS Interface Data Processing

Segment (IDPS), the NOAA Long Term Archive, the EOSDIS Data and Information System (EOSDIS) and other components of NASA-sponsored data and information systems. The science team will assure the incorporation of lessons learned from MODIS, AIRS/AMSU/HSB, and the Pathfinder data set activities.

Using the information gathered in preparing the algorithm analysis report and the operations concept document, team members will support the further refinement of the draft NPP Calibration/Validation Plan. The draft plan is available at:

http://jointmission.gsfc.nasa.gov/science/calibration.html

Team members will provide information to NASA on a variety of topics including, but not limited to, sensor characterization requirements, ancillary data requirements, data system requirements and potential architectures, and the suitability of test data sets and data analysis tools that may be available from the NPOESS system contractor and sensor vendors.

It is also anticipated that the NPP Science Team Members will publish their research results in the open literature.

The full NPP Science Team will consist of these members plus the NPP Program and Project Scientists, an IPO representative, and a representative from the CERES team. Other working members of the NPP Project will usually be in attendance as well. There will be a very close working relationship between this team and the IPO staff and its advisory groups.

Proposal Requirements for Science Team Members

Because of the unusual nature of this science team, care should be taken to document the investigators qualifications for membership. The proposer should identify the specific areas (e.g. which sensor and specific aspects of the sensor or algorithm) in which they intend to contribute and they should document their relevant experience. They should also demonstrate the relevance of the issue to be addressed and their plans to carry out the work.

Technical competence in system design and past participation on hardware development teams may be demonstrated through technical reports as well as through peer-reviewed publications. Proposers should provide all relevant scientific and technical documents or citations in support of their proposed activities.

Proposals will be peer-reviewed on the basis of the qualifications of the proposer and the significance of his/her recent related accomplishments and work, past experience and participation on science advisory and/or review groups or strategic planning activities, the relevance of the specific plans for participation, and the quality and specificity of the proposed approaches.

Information about this NASA Research Announcement

This NRA is open to all scientific investigators who meet the requirements of this NRA. Awards will be for the period of 36 months. Approximately $8M is available for the duration of this award period, with individual funding levels dependent upon the range of activities proposed and the total number of team members selected. NASA retains the option of extending awards beyond the basic period should the selected studies reveal that it is necessary, subject to the availability of funds. Participation in the program is open to all categories of institutions, including educational, industrial, non-profit, NASA centers and other US agencies. Because their duties will necessarily involve access to some data and software that remain company proprietary and competition sensitive, team members and their staff will have to sign non-disclosure agreements with the NPOESS system contractor and their sensor vendors. For this same reason, industrial proposers will have to demonstrate how their activities will be isolated from their parent institution. Due to ITAR restrictions, foreign proposals cannot be accepted for this solicitation.

Proposals may be submitted at any time through March 31, 2003. NASA reserves the right to consider proposals received after that date in accordance with Appendix B, item (g) if the selecting official deems the late proposal to offer significant technical advantage or cost reduction. Proposals submitted to NASA will be evaluated using scientific peer review. Proposals selected for funding will be announced in mid-2003.

Appendices B through D contain NASA general guidelines for the preparation of proposals solicited by this Research Announcement. Appendix E is an Acronym List

Identifier:	NRA 03-OES-01
Submit proposals to:	NPP Science Team NRA NASA Peer Review Services, Code Y 500 E Street SW, Suite 200 Washington, DC 20024-2760 Tel: 202-479-9030
Number of Copies Required:	20
Selecting Official:	Director, Research Division Office of Earth Science NASA Headquarters

Obtain Additional Information From:

Dr. James C. Dodge
Research Division
NASA Headquarters, Code YS
Washington, DC 20546
Tel: (202)-358-0763
Fax: (202)-358-2771
Email: jdodge@hq.nasa.gov

Dr. Robert E Murphy
NPP Project Scientist
Code 920
NASA GSFC
Greenbelt, MD 20771
Tel: (301) 614-5827
Fax: (301) 614-6015
Email: Robert.E.Murphy@nasa.gov

Please use identifier number NRA-03-OES-01 when making an inquiry regarding this announcement. Your interest and cooperation in participating in this effort are appreciated.

Original signed by

Dr. Ghassem R. Asrar
Associate Administrator
Office of Earth Science

NASA RESEARCH ANNOUNCEMENT

EARTH SYSTEM SCIENCE RESEARCH
USING DATA AND PRODUCTS
FROM TERRA, AQUA, AND ACRIM SATELLITES

APPENDIX A: NPOESS Requirements for NPP Sensors

APPENDIX B: Instructions for responding to NASA Research announcements (NRA)

APPENDIX C:

1. Proposal Cover sheet
2. Certifications, Disclosures, and Assurances regarding lobbying, debarment and suspension, and drug-free workplace requirements

APPENDIX D: Budget Summary

APPENDIX E: Acronym List

NASA RESEARCH ANNOUNCEMENT

APPENDIX A
NPOESS REQUIREMENTS FOR NPP SENSORS

This set of requirement statements has been excerpted from the Technical Requirements Document (TRD), APPENDIX "D" of the NPOESS SYSTEM EDR REQUIREMENTS. Original numbering has been retained. This set of EDR requirements is being provided to enable prospective proposers to become members of the NPP Science Team to gauge which EDRs may require additional algorithm enhancement or processing to convert them to CDRs.

1.2 Key EDRs

1.2.1 Atmospheric Vertical Moisture Profile (AVMP)

An atmospheric vertical moisture profile is a set of estimates of average mixing ratio in three-dimensional cells centered on specified points along a local vertical. The specification of this EDR is consistent with that for the CrIMSS; however, TBRs are included for quantification of any performance enhancements resulting from merging other sources (ex: CMIS) to create the IDPS AVMP EDR product. The mixing ratio of a sample of air is the ratio of the mass of water vapor in the sample to the mass of dry air in the sample.

Units: **g**/kg

Para. No.		Thresholds	Objectives
1.2.1-1	a. Horizontal Cell Size	14 km @ nadir	2 km @ nadir
1.2.1-2	b. Horizontal Reporting Interval	1 to 9 per FOR	2 km
1.2.1-3	c. Vertical Cell Size	2 km	2 km
	d. Vertical Reporting Interval		
1.2.1-4	1. Surface to 850 mb	20 mb	5 mb
1.2.1-5	2. 850 mb to 100 mb	50 mb	15 mb
1.2.1-6	e. Horizontal Coverage	Global	Global
1.2.1-7	f. Vertical Coverage	Surface to 100 mb	Surface to 100 mb
1.2.1-8	g. Measurement Range	0-30 g/kg	0 – 30 g/kg
	h. *Measurement Uncertainty (expressed as a percent of average mixing ratio in 2 km layers)		
	Clear		
1.2.1-9	**1. *Surface to 600 mb**	15%	10%
1.2.1-10	2. 600 mb to 300 mb	14%	10%
1.2.1-11	3. 300 mb to 100 mb	12%	10%
	Cloudy		
1.2.1-12	**4. *Surface to 600 mb**	16%	10%

1.2.1-13	5. 600 mb to 300 mb	18%	10%
1.2.1-14	6. 300 mb to 100 mb	17%	10%
1.2.1-15	i. Mapping Uncertainty	5 km	1 km
1.2.1-16	j. Maximum Local Average Revisit Time	8 hrs	3 hrs
1.2.1-17	k. Deleted.		
1.2.1-18	l. Latency (S)	156 min	15 minutes
1.2.1-19	m. Long-term Stability (C) (CrIS/ATMS)	2%	1%

**. Paragraph 1.2.1-16 is satisfied by using the 0530 CMIS in addition to the CrIMSS.

1.2.2 Atmospheric Vertical Temperature Profile (AVTP)

An atmospheric temperature profile is a set of estimates of the average atmospheric temperature in three-dimensional cells centered on specified points along a local vertical. The specification of this EDR is consistent with that for the CrIMSS; however, TBRs are included for quantification of any performance enhancements resulting from merging other sources (ex: CMIS) to create the IDPS AVTP EDR product.

Units: K

Para. No.		Thresholds	Objectives
	a. Horizontal Cell Size		
1.2.2-1	1. Clear, nadir	14 km Surface to 0.5 mb 200 km 0.5 to 0.01mb	1 km
1.2.2-2	2. Clear, worst case	50 km	(TBD)
1.2.2-3	3. Cloudy, nadir	40 km	1 km
1.2.2-4	4. Cloudy, worst case	200km	(TBD)
1.2.2-5	b. Horizontal Reporting Interval	One to nine per FOR	(TBD)
	c. Vertical Cell Size		
	Clear		
1.2.2-6	1. Surface to 300 mb	1 km	(TBD)
1.2.2-7	2. 300 mb to 30 mb	3 km	(TBD)
1.2.2-8	3. 30 mb to 1 mb	5 km	(TBD)
1.2.2-9	4. 1 mb to 0.5 mb	5 km	(TBD)
1.2.2-40	5. 0.5 to 0.01 mb	5 km	(TBD)
	Cloudy		
1.2.2-10	6. Surface to 700 mb	1 km	(TBD)
1.2.2-11	7. 700 mb to 300 mb	1 km	(TBD)
1.2.2-12	8. 300 mb to 30 mb	3 km	(TBD)
1.2.2-13	9. 30 mb to 1 mb	5 km	(TBD)
1.2.2-14	10. 1 mb to 0.5 mb	5 km	(TBD)
1.2.2-41	11. 0.5 to 0.01 mb	5 km	(TBD)
	d. Vertical Reporting Interval		
1.2.2-15	1. Surface to 850 mb	20 mb	10 mb
1.2.2-16	2. 850 mb to 300 mb	50 mb	10 mb
1.2.2-17	3. 300 mb to 100 mb	25 mb	15 mb
1.2.2-18	4. 100 mb to 10 mb	20 mb	10 mb
1.2.2-19	5. 10 mb to 1 mb	2 mb	1 mb
1.2.2-20	6. 1 mb to 0.1 mb	0.2 mb [1 mb to .5 mb]	0.1 mb
1.2.2-21	7. 0.1 mb to 0.01 mb	0.02 mb	0.01 mb
1.2.2-22	e. Horizontal Coverage	Global	Global
1.2.2-23	f. Vertical Coverage	Surface to 0.01 mb	Surface to 0.01 mb
1.2.2-24	g. Measurement Range	180-335K [Earth Scene] 180-310K [Black Body]	162-335 K (TBR)

1.2.2-25	Not Used		
	h. ***Measurement Uncertainty		
	Clear		
1.2.2-26	**1. *Surface to 300 mb**	0.9 K/1 km layer	0.5 K/1 km
1.2.2-27	2. 300 mb to 30 mb	0.98 K/3 km layers	0.5 K/1 km
1.2.2-28	3. 30 mb to 1 mb	1.45 K/5 km layers	0.5 K/1 km
1.2.2-29	4. 1 mb to 0.3 mb**	3.5 K /5 km layers	0.5 K/1 km
1.2.2-42	5. 0.3 to 0.01 mb	6.5 K/5 km layer	0.5 K/1 km
	Cloudy		
1.2.2-30	**6. *Surface to 700 mb**	2.0 K/ 1 km layer	0.5 K/1 km
1.2.2-31	7. 700 mb to 300 mb	1.4 K/ 1 km layer	0.5 K/1 km
1.2.2-32	8. 300 mb to 30 mb	1.3 K/ 1 km layer	0.5 K/1 km
1.2.2-33	9. 30 mb to 1 mb	1.45 K/ 1 km layer	0.5 K/1 km
1.2.2-34	10. 1 mb to 0.0.5 mb	3.5 K /1 km layer	0.5 K/1 km
1.2.2-43	11. 0.5 to 0.01 mb	6.5 K/ 5 km layer	0.5 K/1 km
1.2.2-35	i. Mapping Uncertainty	5 km	1 km
1.2.2-36	j. Maximum Local Average Revisit Time	6 hrs (TBR)	3 hrs
1.2.2-37	k. Deleted.		
1.2.2-38	l. Latency (S)	156 min	15 minutes
1.2.2-39	m. Long Term Stability (C) (CrIS/ATMS)	Trop Mean 0.05 K Strat. Mean 0.1 K	Trop 0.03 K Strat. 0.05 K

*** Measurement Uncertainty as specified in 1.2.2-29 and –42 shall be referenced to the Cloudy Horizontal Cell Size thresholds and objectives as provided by the CMIS sensor.

1.2.3 Imagery

Imagery requirements fall into three classes: (a) explicit requirements on the EDR content, quality, reporting frequency, and timeliness, (b) requirements to be derived based on specific applications utilizing the imagery EDR, such as manual generation of cloud and sea ice data, and (c) requirements to be derived by the contractor based on requirements for other EDRs supported by the imagery. The explicit and application-related requirements are specified below. (Automated generation of cloud data is addressed in other EDRs and therefore will not be addressed below.)

1.2.3.1 Explicit EDR Requirements

Imagery is defined as the measured locally-averaged upwelling radiance or equivalent black body temperature from the earth's surface and atmosphere in one or more spectral bands, where the local averages are reported for the points of a two-dimensional approximately rectangular lattice. (The lattice is only approximately rectangular primarily because of the steep scan angle near the edge-of-scan and increased range to scene compared to nadir.) The form of the weighting function that determines the local average is constrained by the horizontal spatial resolution requirement. The number of spectral bands, band limit values, measurement ranges, and measurement uncertainty requirements are to be derived based on the application-related requirements given below and on the requirements of other EDRs supported by the imagery. However, at least one daytime visible, one nighttime visible, and at least one IR channel are required. Daytime and nighttime visible imagery must be merged so as to minimize the apparent transition across the terminator. The requirements for cloudy conditions are less stringent and apply when atmospheric conditions preclude the use of infrared sensing, but which can be met by microwave (or any comparable technology) sensing. Unless otherwise specified, the explicit EDR requirements below apply to each spectral band that is required for the Application-Related requirements of section 1.2.3.2 and at a minimum, to at least one daytime visible, one nighttime visible, and one IR channel (TBR). The explicit horizontal spatial resolution and mapping uncertainty requirements specified below do not apply to microwave imagery.

TRD1.2.3.1-1
Brightness temperatures from each microwave channel and polarization, if applicable, shall be available for display at the sampled resolution.

Para. No.		Threshold	Objectives
	a. ***Horizontal Spatial Resolution (HSR)**		
1.2.3.1-2	**Deleted**		
1.2.3.1-3	Deleted		
1.2.3.1-4	**1. Nadir**	**0.4 km**	0.1 km
1.2.3.1-5	2 Worst case	0.8 km	0.1 km
1.2.3.1-6	3. Nighttime Visible, worst case	0.74 km	0.65 km
1.2.3.1-18	4. All Weather	40 km	20 km
1.2.3.1-7	b. Horizontal Reporting Interval	Imagery HSR	Derived (gapless or near gapless coverage)
1.2.3.1 –8	c. Horizontal Coverage	Global	Global
1.2.3.1-9	Deleted		
	d. Measurement Range		
1.2.3.1-10	1. Nighttime visible	4.00E-09 to 3.00E-02	Includes threshold range

		$W/(cm^2sr)$	
1.2.3.1-11	2. Other bands	0.645 band 5.0 to 468 $W/(m^2 sr \mu m)$ 3.7 band 210 K to 353 K 11.45 band 190 K to 340 K	Derived
1.2.3.1-12	e. Measurement Uncertainty	Derived	Derived
	f. Mapping Uncertainty		
1.2.3.1-13	1. At nadir	0.4 km	0.4 km
1.2.3.1-14	2. Worst case	1.5 km	0.5 km
1.2.3.1-19	3. All Weather	3 km	
1.2.3.1-15	**g. *Maximum Local Average Revisit Time**	**4 hrs**	(TBD)
1.2.3.1-16	**h. *Maximum Local Refresh**	**6 hrs**	(TBD)
1.2.3.1-17	**i. *Fraction of Revisit Times Less Than a Specified Value**	**At any location at least 75 % of the revisit times will be 4 hours or less**	(TBD)
1.2.3.1-20	j. Latency (S)	90 minutes	15 minutes

1.2.3.2 Application-Related Requirements

TRD 1.2.3.2-1

The content, quality, and reporting frequency of the imagery shall suffice to support the following application-related requirements. These requirements, together with requirements of other EDRs supported by the imagery, determine the derived requirements in the explicit EDR requirement set above and may drive specified values of non-derived attributes to more stringent values. The content of the application-related data products is not part of the content of the imagery EDR. It is assumed that flowdown of application-related requirements to explicit imagery requirements will be performed by contractor simulation and modeling.

1.2.3.2.1 Manually Generated Cloud Data

Manually generated cloud data are estimates of cloud cover and cloud type generated by a human analyst viewing the unprocessed and/or processed imagery derived from the unprocessed imagery, e.g., by data fusion, spatial rescaling, image enhancement, etc.

1.2.3.2.1.1 Cloud Cover

Cloud cover is defined as the fraction of a given area, i.e., of a horizontal cell, on the Earth's surface for which a locally normal line segment extending between two given altitudes, intersects a detectable cloud as defined in the Glossary. For manual analyses, cloud cover is estimated for a single atmospheric layer. Specifically, the minimum and maximum altitudes of this layer are defined to be the surface of the Earth and the altitude where the pressure is 0.1 mb. Haze, smoke, dust, and rain are not to be considered clouds. For the purpose of validating this requirement, cloud cover estimates are to be generated by a trained human analyst viewing unprocessed and/or processed imagery for contiguous square areas having side length equal to the horizontal cell size specified below.

Units: Dimensionless

Para. No.		Threshold	Objectives
1.2.3.2.1.1-6	a. Horizontal Cell Size	3 times HSR (1.2 km at nadir)	2 times the Imagery HSR
1.2.3.2.1.1-1	Deleted		
1.2.3.2.1.1-2	Deleted		
1.2.3.2.1.1-3	b. Horizontal Reporting Interval	Horizontal cell size	Horizontal cell size
1.2.3.2.1.1-4	c. Measurement Range	0 – 1, 0.1 increments	0 – 1, 0.1 increments
1.2.3.2.1.1-5	d. Measurement Uncertainty	0.1	0.1

1.2.3.2.1.2 Cloud Type

Cloud types are defined as follows:

(1) Altocumulus (AC) (2) Altocumulus Castellanus (ACCAS) (3) Altocumulus (standing lenticular) (ACSL) (4) Altostratus (AS) (5) Cirrocumulus (CC) (6) Cirrocumulus (standing lenticular) (CCSL) (7) Cirrostratus (CS) (8) Cirrus (CI) (9) Cumulonimbus (CB) (10) Cumulus (CU) (11) Cumulus Fractus (CUFRA) (12) Towering Cumulus (TCU) (13) Stratus Fractus (STFRA) (14) Nimbostratus (NS) (15) Stratocumulus (SC) (16) Stratocumulus (Standing lenticular) (SCSL) (17) Stratus (ST)

Cloud typing not only entails a capability to distinguish between clouds of different types, but also a capability to distinguish clouds from other features, such as snow, cold water, cold land, haze, smoke, dust, etc. Therefore, the following additional types are defined: (18) Obscured/not cloudy (19) Clear.

A given area is classified as "obscured/not cloudy" if there are no detectable clouds within the atmosphere overlying the area and if the average vertical LOS extinction optical thickness of the atmosphere overlying the area is > 0.03 (TBR) 0.645 μm region. A given area is classified as

"clear" if there are no detectable clouds, as defined above, overlying the area and if the average vertical LOS extinction optical thickness of the atmosphere overlying the area is < 0.03 in the 0.645 μm region. Note that other EDRs require the type of non-cloud obscuration to be discerned and identified, e.g., smoke, dust, sand, ash, etc.

For the purpose of validating this requirement, typing is performed by a trained human analyst viewing unprocessed and/or processed imagery for contiguous square areas having side length equal to the horizontal cell size specified below. The probability of correct typing is defined as the probability that a cell reported as being of type x is in fact of type x, where x is any of the types specified above.

Units: N/A

Para. No.		Threshold	Objectives
1.2.3.2.1.2-7	a. Horizontal Cell Size	3 times HSR (1.2 km at nadir)	(TBD) times Imagery HSR
1.2.3.2.1.2-1	Deleted		
1.2.3.2.1.2-2	Deleted		
1.2.3.2.1.2-3	b. Horizontal Reporting Interval	Horizontal cell size	Horizontal cell size
1.2.3.2.1.2-4	c. Measurement Range	14 cloud types **	Clear, obscured/not cloudy, all 17 cloud types
1.2.3.2.1.2-8	d. Probability of Correct Typing	85%	90% at (TBS) % confidence level
1.2.3.2.1.2-5	Deleted		
1.2.3.2.1.2-6	Deleted		

** Altocumulus (AC); Altostratus (AS); Cirrocumulus (CC); Cirrocumulus (standing lenticular) (CCSL); Cirrostratus (CS); Cirrus (CI); Cumulonimbus (CB); Cumulus (CU); Towering Cumulus (TCU) ; Stratocumulus (SC); Stratocumulus (standing lenticular) (SCSL); Stratus (ST); Obscured/not cloudy; Clear.

1.2.3.2.2 Sea Ice Data

Sea ice data may be generated interactively by a human analyst viewing unprocessed or processed imagery at a computer workstation, or automatically via an algorithm. In addition to determination of ice edge location and ice concentration as described below, analysts will attempt to determine the thickness and size of leads and polynyas based on the imagery.

1.2.3.2.2.1 Ice Edge Location

An ice edge is defined as the boundary between ice-covered sea water (ice concentration > 0.1) and sea water not covered by ice (ice concentration $\leq$ 0.1). Ice concentration is defined as the fraction of a given area sea or water covered by ice. An ice edge is typically provided as a contour on a map or in digital form as a set of latitude/longitude coordinates. The ice edge location error is defined as the distance between the estimated location of an ice edge and the nearest location of a true ice edge.

Units: Degrees latitude and longitude

Para. No		Threshold	Objectives
1.2.3.2.2.1-1	a. Horizontal Coverage	North of 36 deg north latitude, south of 50 deg south latitude for sea ice	North of 36 deg north latitude, south of 50 deg south latitude for sea ice
1.2.3.2.2.1-2	b. Measurement Range	Any latitude, longitude in degrees within horizontal coverage	Any latitude, longitude within coverage domain
	c. Measurement Uncertainty		
1.2.3.2.2.1-3	1. Clear	0.4 at nadir 1.0 km worst case	(TBD)
1.2.3.2.2.1-4	2. Cloudy	(TBD)	(TBD)
1.2.3.2.2.1-5	3. Deleted		
1.2.3.2.2.1-6	4. Deleted		

1.2.3.2.2.2 Ice Concentration

Ice concentration is defined as the fraction of a given area of sea water covered by ice. It is typically derived from imagery and reported on ocean geographical charts for areas between contours generated by an analyst.

Units: Dimensionless

Para. No.		Threshold	Objectives
1.2.3.2.2.2-1	a. Horizontal Coverage	North of 36 deg north latitude, south of 50 deg south latitude for sea ice	North of 36 deg north latitude, south of 50 deg south latitude for sea ice
1.2.3.2.2.2-2	b. Measurement Range	0 – 1 HCS Area , 0.1 increments	0 – 1, 0.1 increments
1.2.3.2.2.2-3	c. Measurement Uncertainty	0.1	0.1

1.2.4 Sea Surface Temperature (SST)

Sea surface temperature (SST) is defined as a highly precise measurement of the temperature of the surface layer (skin) and upper 1 meter (bulk) of ocean water. It has two major applications: (1) sea surface phenomenology, and (2) use in infrared cloud/no cloud decisions for processed cloud data. SST imagery is a mapped digital image of SST employing the maximum resolution of the sensed data, but having relaxed accuracy and precision requirements from the main SST product. The requirements below apply only under clear conditions unless otherwise stated.

Units: K

Para. No.		Threshold	Objectives
	a. *Horizontal Cell Size		
1.2.4.1	Deleted		
1.2.4.2	Deleted		
1.2.4-3	**1. *Nadir**	**0.8 km**	0.25 km
1.2.4-4	2. Worst case, clear	1.3 km	(TBD)
1.2.4 –18	3. All Weather	40 km	20 km
1.2.4-24			
1.2.4-5	b. Horizontal Reporting Interval	HCS	(TBD)
1.2.4-23	c. Horizontal Coverage	Oceans	Oceans
1.2.4.6	Deleted		
1.2.4.7	Deleted		
1.2.4-8	d. Measurement Range	271 K – 313 K	271 K – 313 K
	e. Measurement Uncertainty (skin)		
1.2.4 – 9	**1. * Clear**	**0.5 K**	0.1 K
1.2.4 – 20	2. All Weather	0.5 K	0.5 K
1.2.4-25	3. Deleted		
1.2.4-10	f. Measurement Uncertainty (bulk)	0.5 K	0.1 K
	g. Measurement Precision (skin)		
1.2.4 –11	1. Clear	0.27 K	0.1 K
1.2.4-19	2. All Weather	0.5 K	0.1 K
1.2.4-26	3. Deleted		
	h. Mapping Uncertainty		
1.2.4-12	1. Nadir	0.4 km	0.1 km
1.2.4-13	2. Worst case, clear	0.8 km	(TBD)
1.2.4-14	3. All Weather	3 km	3 km
1.2.4-27	4. Deleted		
1.2.4-15	Deleted		
1.2.4-16	i. Maximum Local Average Revisit Time	6 hrs	3 hrs
1.2.4-17	Jj. Measurement Precision (bulk, clear).	0.2 K	0.1 K
1.2.4-21	k. Long Term Stability (C)	0.1 K	0.05 K
1.2.4-22	l. Latency (S)	90 minutes	15 minutes

*1.2.6 *Soil Moisture*

Total water in all phases in the soil or in a surface layer over soil. The threshold requirement is to measure soil moisture only within a thin layer at the surface (0.1 cm thick) and only for bare soil in regions with known soil types. The objective is to measure a moisture profile for any soil, whether bare or not, and whether or not the soil type is known.

Units: cm/m (cm of water per meter of soil depth)

Para. No.		Threshold	Objectives
	a. Horizontal Cell Size		
1.2.6-1	1. Clear daytime, at nadir	0.75 km	(TBD)
1.2.6-2	2. Clear daytime, worst case	1.6 km	1.6 km
1.2.6-3	3. All weather, at nadir	40 km	2 km
1.2.6-4	4. All weather, worst case	50 km	(TBD)
1.2.6-5	b. Horizontal Reporting Interval	HCS	(TBD)
1.2.6-6	c. Vertical Cell Size	0.1 cm	5 cm
1.2.6-7	d. Vertical Reporting Interval		
1.2.6-8	e. Horizontal Coverage	Land	Land
1.2.6-9	**f. *Vertical Coverage**	Surface to –0.1 cm (SKIN LAYER)	Surface to –80 cm
1.2.6-10	g. Measurement Range	0 – 100 cm/m	0 – 100 cm/m
	h. Measurement Uncertainty		
1.2.6-11	1. Clear, Bare soil in regions with known soil types (smaller horizontal cell size)	Surface: 5 cm/m up to field capacity, 10 cm/m beyond capacity	Surface: 1% 80 cm column: ±5 %
1.2.6-12	2. Cloudy , Bare soil in regions with known soil types (greater horizontal cell size)	20 cm/m	Surface: 1 cm/m Total 80 cm column: 5 %
1.2.6-13	i. Mapping Uncertainty	1.5 km	1 km
1.2.6-14	j. Maximum Local Average Revisit Time	8 hrs	3 hrs
1.2.6-15	k. Deleted		
1.2.6-16	l. Latency (S)	90 minutes	30 minutes

1.3 Atmospheric EDRs

1.3.1 Aerosols

Aerosols are defined as suspensions of liquid droplets or solid particles in the atmosphere. Aerosols include, but are not limited to, smoke, dust, sand, volcanic ash, sea spray, polar stratospheric clouds, and smog. Water and ice clouds are also aerosols, but because of the frequency of their occurrence and their importance to military operations, they are addressed separately in another EDR (See Sec. 1.2.3, Imagery).

1.3.1.1 Aerosol Optical Thickness

Aerosol optical thickness (AOT), for this EDR, is defined as the extinction (scattering + absorption) vertical optical thickness of modes 1 (~0.1 μm) and 2 (1.0 μm) of the bimodal aerosol size distribution at multiple wavelengths within the 0.4 – 2.4 micron spectral range (# applies to total column optical depth). Attributes designated as "Climate" require a polarimeter in addition to a high-resolution imager to attain threshold values. Optical thickness (τ) is related to transmission (t) by $t = \exp(-\tau)$. The refresh requirement for the climate products is to provide observations from the satellite nadir-track of any satellite carrying the aerosol polarimeter. The requirements below apply only under clear and daytime conditions.

Units: Dimensionless

Para. No.		Threshold	Objectives
1.3.1.1-1	a. Horizontal Cell Size	1.6 km over ocean; 9.6 km over land	1 km
1.3.1.1-2	b. Horizontal Reporting Interval	HCS	(TBD)
1.3.1.1-3	c. Vertical Cell Size	Total Column	50 km
1.3.1.1-4	1. [0 – 2 km]	N/A	0.25 km
1.3.1.1-5	2. [2 – 5 km]	N/A	0.5 km
1.3.1.1-6	3. [> 5 km]	N/A	1 km
1.3.1.1-7	d. Vertical Reporting Interval	Vertical cell size	Vertical cell size
1.3.1.1-8	e. Horizontal Coverage	Global	Global
1.3.1.1-9	f. Vertical Coverage	0 – 50 km	0 – 50 km
	g. Measurement Range		
1.3.1.1-10	1. Operational	0.0 to 2.0 units of τ	0-10
1.3.1.1-18	2. Climate	0.0 to 5.0 units of τ	0-10
	h. Measurement Accuracy		
1.3.1.1-11	1. Operational, Over Ocean	$\tau < 0.5$ -- 0.02 $\tau \geq 0.5 – 0.07\tau - 0.015$	0.01
1.3.1.1-19	2. Climate, Over Ocean	Greater of 0.02 or 7%	Greater of .01 or 5%
1.3.1.1-12	3. Operational, Over Land	$\tau < 1$ -– 0.1 $\tau \geq 1$ -- 0.15	0.1
1.3.1.1-20	4. Climate, Over Land	Greater of 0.04 or 10%	Greater of 0.03 or 7%
	i. Measurement Precision		
1.3.1.1-13	1. Operational	Over ocean $\tau \leq 0.6$ -- 0.02 $\tau > 0.6$ --0.03 Over land – 0.1	0.01
1.3.1.1-21	2. Climate, Over Ocean	0.01	0.005
1.3.1.1-22	3. Climate, Over Land	0.03	0.02
1.3.1.1-14	j. Long Term Stability	0.01	0.003
1.3.1.1-15	k. Mapping Uncertainty	1.5 km	1 km

	l. Maximum Local Average Revisit Time		
1.3.1.1-16	1. Operational (S)	6 hrs	4 hrs
1.3.1.1-23	2. Climate	N/A	N/A
1.3.1.1-17	m. Deleted.		
1.3.1.1-24	n. Measurement Uncertainty, Operational, over land	$\tau<0.45$ $0.05+0.2\tau$ $0.45<\tau\leq 1$ 0.14 $\tau>1$ 0.18	

1.3.1.2 Aerosol Particle Size Parameter

Aerosol particle size may be characterized by two different parameters, the Ångström wavelength exponent and the effective radius. The Ångström wavelength exponent "alpha" (α) is defined by:

$$\alpha = - \Delta \ln \tau / \Delta \ln \lambda$$

where: "tau" (τ) is the extinction (scattering + absorption) vertical optical thickness of the aerosols within specified layers of the atmosphere, "lambda" (λ) is the wavelength, and "delta" (Δ) refers to the difference between measurements in two narrow bands. The effective radius is the area weighted average radius of the aerosol particle size distribution or, equivalently, the ratio of the third to the second moments of the size distribution. The threshold requirement is to measure the Ångström wavelength exponent based on two different narrow wavelength bands (bandwidth ≤ 0.05 μm) within the 0.4 to 1.0 micron spectral range for which the midpoint wavelengths are separated by at least 0.2 μm, and meet the data content and quality requirements pertaining to this parameter in the threshold column of the table below. The objective is to measure the effective radius of the aerosol particle size distribution and meet the data content and quality objectives pertaining to this parameter given in the table below.
For the climate applications, the size denotes a measurement of the bimodal size distribution of the aerosol population in terms of the effective radius r_e and effective variance ν_e of each mode. The effective radius is the ratio of the third moment of the aerosol size distribution to the second moment. The effective variance characterizes the width of the size distribution. Attributes designated as "Climate" require a polarimeter in addition to a high-resolution imager to attain threshold values. The refresh requirement for the climate products is to provide observations from the satellite nadir-track of any satellite carrying the aerosol polarimeter. The requirements below apply only under clear and daytime conditions. ($\notin$ - applies only to sub-satellite pixels.)

Units: Ångström Wavelength Exponent: Dimensionless.
Effective Radius: μm

Para. No.		Threshold	Objectives (Pertaining to effective radius)
1.3.1.2-1	a. Horizontal Cell Size	1.6 km over ocean 9.6 km over land	1 km
1.3.1.2-2	b. Horizontal Reporting Interval	HCS	(TBD)
1.3.1.2-3	c. Vertical Cell Size	Total column	50 km
1.3.1.2-4	1. [0 – 2 km]	N/A	0.25 km
1.3.1.2-5	2. [2 – 5 km]	N/A	0.5 km
1.3.1.2-6	3. [> 5 km]	N/A	1 km
1.3.1.2-7	d. Vertical Reporting Interval	N/A	Vertical cell size
1.3.1.2-8	e. Horizontal Coverage	Global	Global
1.3.1.2-9	f. Vertical Coverage	0 – 30 km	0 – 50 km
	g. Measurement Range		
1.3.1.2-10	1. Operational	-1 to +3 units of α	0.05 to 5 μm
1.3.1.2-17	2. Climate	0 to 5 μm or 10% for r_e 0 to 3 for ν_e	0 to 10 μm or 10% for r_e 0 to 5 for ν_e
	h. Measurement Accuracy		

1.3.1.2-11	1. Operational	Ocean $\tau<0.04$ – 0.3 Ocean $\tau\geq0.04$ – 0.1 Land 0.6	10 %
1.3.1.2-19	2. Climate	Greater of 0.1μm or 10% for r_e Greater of 0.3 or 50% for ν_e ≠	Greater of 0.05 μm or 5% for r_e Greater OF 0.2 OR 30% for ν_E
	i. Measurement Precision		
1.3.1.2-12	1. Operational	Ocean $\tau<0.04$ – 0.3 Ocean $\tau\geq0.04$ – 0.1 Land 0.6	10%
1.3.1.2-18	2. Climate	Greater of 0.05μm or 10% for r_e Greater of 0.1 or 40% for ν_e ≠	Greater of 0.05 μm or 5% for r_e Greater of 0.1 or 20% for ν_e
1.3.1.2-13	j. Long Term Stability (C)	Greater of 0.05μm or 10% for r_e Greater of 0.2 or 40 % for ν_e ≠	Greater of 0.05 μm or 5% for r_e Greater of 0.1 or 20 % for ν_e
1.3.1.2-14	k. Mapping Uncertainty	1.5 km	1 km
	l. Maximum Local Average Revisit Time (S)		
1.3.1.2-15	1. Operational	6 hrs	4 hrs
1.3.1.2-20	2. Climate	N/A	N/A
1.3.1.2-16	m. Deleted.		

1.3.1.3 Suspended Matter

As a threshold, the required content of this EDR is to report the presence of suspended matter such as dust, sand, volcanic ash, SO_2, or smoke at any altitude. The objective is to report the presence of suspended matter in 0.2 km thick layers of the atmosphere, including sea salt and radioactive material. Other objectives are discriminating and classifying different types of suspended matter, for clearly delineated types, and reporting the concentrations of suspended matter types. Minimum detectable concentration levels for suspended matter types are not specified, and will be a by-product of capabilities required by other EDRs. The requirements below apply only under clear, daytime conditions.

Units:
Typing: N/A
Concentration: $\mu g/m^3$

Para. No.		Threshold	Objectives
1.3.1.3-1	a. Horizontal Cell Size	1.6 km	1 km
1.3.1.3-2	b. Horizontal Reporting Interval	HCS	(TBD)
1.3.1.3-3	c. Vertical Cell Size	Total Column	0.2 km
1.3.1.3-4	d. Vertical Reporting Interval	N/A	Vertical Cell Size
1.3.1.3-5	e. Horizontal Coverage	Global	Global
1.3.1.3-6	f. Vertical Coverage	0-30 km	(TBD)
	g. Measurement Range		
1.3.1.3-14	1. Detection	Flag cells where atmosphere contains suspended matter	Flag atmospheric layers containing suspended matter
1.3.1.3-7	2. Type	Dust, sand, volcanic ash, sea salt, smoke, SO_2	Dust, sand, volcanic ash, sea salt, smoke, SO_2, radioactive material, other
1.3.1.3-8	3. Concentration	0 – 1000 $\mu g/m^3$ for smoke	0 – 100 $\mu g/m^3$ for smoke, other types (TBD)
1.3.1.3-9	h. Probability of Correct Typing	Suspended matter 90% Dust/sand 85% Smoke 85% Volcanic Ash 85% Sea Salt 85% SO_2 85%	(TBD) for classes
1.3.1.3-10	i. Measurement Uncertainty (concentration)	Smoke 50%	(TBD)
1.3.1.3-11	j. Mapping Uncertainty	1.5 km	0.1 km
1.3.1.3-12	k. Maximum Local Average Revisit Time (S)	12 hrs	3 hrs
1.3.1.3-13	l. Deleted.		
1.3.1.3-15	m. Latency (S)	90 minutes	15 minutes

1.3.5 Pressure Profile

A pressure profile is a set of estimates of the atmospheric pressure at specified altitudesabove the earth's surface. The specification of this EDR is consistent with that for the CrIMSS; however, TBRs are included for quantification of any performance enhancements resulting from merging other sources (ex: CMIS) to create the IDPS Pressure Profile EDR product. The requirements below apply under both clear and cloudy conditions.

Units: mb

Para. No.		Thresholds	Objectives
1.3.5-1	a. Horizontal Cell Size	25 km,	5 km
1.3.5-2	b. Horizontal Reporting Interval	25 km	5 km
1.3.5-3	c. Vertical Cell Size	0 km	0 km
	d. Vertical Reporting Interval		
1.3.5-4	1. [0 – 2 km]	1 km	0.25 km
1.3.5-5	2. [2 – 5 km]	1 km	0.5 km
1.3.5-6	3. [> 5 km]	1 km	1 km
1.3.5-7	e. Horizontal Coverage	Global	Global
1.3.5-8	f. Vertical Coverage	0-30 km	0 – 30 km
1.3.5-9	g. Measurement Range	10-1050 mb	10 – 1050 mb
	h. Measurement accuracy		
1.3.5-10	1. [0 – 2 km]	3%	
1.3.5-11	2. [2 – 10 km]	3 %	0.5%
1.3.5-12	3. [10 – 30 km]	5 % [10-30 km]	0.5 %
1.3.5-13	i. Measurement Precision	3 mb	2 mb
1.3.5-14	j. Mapping Uncertainty	3 km	1 km
1.3.5-15	k. Maximum Local Average Revisit Time (S)	8 hrs	1 hr
1.3.5-16	l. Deleted.		
1.3.5-17	m. Latency (S)	156 minutes	15 minutes

1.4 Cloud EDRs

In this section "cloud" always means "detectable cloud" as defined in the glossary.

1.4.1 Cloud Base Height

Cloud base height is defined as the height above ground level where cloud bases occur. More precisely, for a cloud covered earth location, cloud base height is the set of altitudes of the bases of the clouds that intersect the local vertical at this location. The reported heights are horizontal spatial averages over a cell, i.e., a square region of the earth's surface. If a cloud layer does not extend over an entire cell, the spatial average is limited to the portion of the cell that is covered by the layer. As a threshold, only the height of the base of the lowest altitude cloud layer is required and the objective is to report cloud base height for all distinct cloud layers.

Units: km

Para. No.		Threshold	Objectives
	a. Horizontal Cell Size		
1.4.1-1	1. Moderate	10 km	1.0 km
1.4.1-10	2. Fine, nadir	6 km	1.0 km
1.4.1-2	b. Horizontal Reporting Interval	HCS	HCS
1.4.1-3	c. Horizontal Coverage	Global	Global
	d. Vertical Cell Size	N/A	N/A
1.4.1-4	e. Vertical Reporting Interval	Base of highest cloud and lowest cloud	Base of all distinct cloud layers
1.4.1-5	f. Measurement Range	0 – 20 km	0 – 30 km
1.4.1-6	g. Measurement Uncertainty	2 km	0.25 km
1.4.1-7	h. Mapping Uncertainty	1.5 km	1 km
1.4.1-8	i. Maximum Local Average Revisit Time (S)	6 hrs	4 hrs
1.4.1-9	j. Deleted.		
1.4.1-11	k. Long Term Stability (C)	2.0 km	0.1 km
1.4.1-12	l. Latency (S)	90 minutes	15 minutes

1.4.2 Cloud Cover/Layers

Cloud cover is defined as the fraction of a given area on the earth's surface for which a locally normal line segment, extending between two given altitudes, intersects a cloud. As a threshold, cloud cover is required for up to four layers of the atmosphere between the surface and an altitude of 20 km. As an objective, cloud cover is required for contiguous, 0.1 km thick layers at 0.1 km increments in altitude, from the surface of the earth to an altitude of 30 km. The product will also include a binary (cloudy/not cloudy) map indicating the HCSs which contain clouds.

Units: Dimensionless

Para. No.		Threshold	Objectives
	a. Horizontal Cell Size		
1.4.2-1	1. Moderate	25 km	1 km
1.4.2-12	2. Fine, nadir	6 km	1 km
1.4.2-2	b. Horizontal Reporting Interval	HCS	(TBD)
	c. Vertical Cell Size	N/A	N/A
1.4.2-3	d. Vertical Reporting Interval	4 layers	0.1 km
1.4.2-4	e. Horizontal Coverage	Global	Global
1.4.2-5	f. Vertical Coverage	0 – 20 km	0 – 30 km
1.4.2-6	g. Measurement Range	0 – 1.0 HCS Area	0 – 1.0
1.4.2-7	h. Measurement Accuracy	0.07 HCS area (nadir) 0.1 HCS area (EOS)	0.05
1.4.2-8	i. Measurement Precision	0.07 HCS area (nadir) 0.15 HCS area (EOS)	0.025
1.4.2-9	j. Mapping Uncertainty	1.5 km	1 km
1.4.2-10	k. Max Local Average Revisit Time (S)	6 hrs	4 hrs
1.4.2-11	l. Deleted.		
1.4.2-13	m. Latency (S)	90 minutes	15 minutes
1.4.2-14	n. Binary Map HCS	Pixel Size	
1.4.2-15	o. Binary Map HRI	HCS	
1.4.2-16	p. Binary Map Measurement Range	Cloudy/not cloudy	
1.4.2-17	q. Binary Map Probability of Correct typing	Day, Ocean, OD≤0.5 92% Day, Ocean, OD>0.5 99% Day, Land, OD≤1 85% Day, Land OD>1 93% Night, Ocean OD≤0.5 90% Night, Ocean, OD>0.5 96% Night, Land, OD≤1 85% Night, Land, OD>1 90%	

1.4.3 Cloud Effective Particle Size

Effective cloud particle size is defined as the ratio of the third moment of the drop size distribution to the second moment, averaged over a layer of air within a cloud.

Units: μm

Para. No.		Threshold	Objectives
1.4.3-1	a. Horizontal Cell Size	25 km (Moderate, EOS) 5 km (Fine, nadir)	10 km
1.4.3-2	b. Horizontal Reporting Interval	HCS	(TBD)
1.4.3-3	c. Vertical Cell Size	Vertical Reporting Interval	Vertical Reporting Interval
1.4.3-4	d. Vertical Reporting Interval	Up to 4 layers	0.3 km
1.4.3-5	e. Horizontal Coverage	Global	Global
1.4.3-6	f. Vertical Coverage	0 – 20 km	0 – 30 km
1.4.3-7	g. Measurement Range	0-50 μm	(TBD)
1.4.3-8	h. Measurement Accuracy	5.5μm (Day, water, OD≤1) 8μm (Day, ice, OD≤1) 2μm (Day, water, OD>1) 3.5μm (Day, ice, OD>1) 4μm (Night)	Greater of 5% or 2 μm
1.4.3-9	i. Measurement Precision	1μm (Day, water) 1.5μm (Day, ice,) 2μm (Night)	2%
1.4.3-10	j. Long Term Stability	2%	1%
1.4.3-11	k. Mapping Uncertainty	1.5 km	1 km
1.4.3-12	l. Maximum Local Average Revisit Time (S)	6hrs	3 hrs
1.4.3-13	m. Deleted.		
1.4.3-14	n. Latency (S)	90 minutes	15 minutes
1.4.3-15	o. Fine Measurement Uncertainty	5.5μm (Day, water, OD≤1) 12μm (Day, ice, OD≤1) 2.5 μm (Day, water, OD>1) 4μm (Day, ice, OD>1) 4μm (Night)	

1.4.6 Cloud Optical Thickness (IORD Name: Cloud Optical Depth/Transmissivity)

Cloud optical thickness is defined as the extinction (scattering + absorption) vertical optical thickness of each and every distinguishable cloud layer in a vertical column of the atmosphere as well as the total optical thickness of all layers in aggregate. Optical thickness (τ) is related to transmittance (t) by $t = \exp(-\tau)$.

Units: Dimensionless

Para. No.		Threshold	Objectives
	a. Horizontal Cell Size		
1.4.6-1	1. Moderate	25 km	10 km
1.4.6-11	2. Fine , nadir	5 km	1 km
1.4.6-2	b. Horizontal Reporting Interval	HCS	(TBD)
1.4.6-3	c. Horizontal Coverage	Global	Global
1.4.6-4	d. Measurement Range	0.1 to 64 (τ units) Day, water 0.1 to 10 (τ units) Day, ice 0.5 to 10 (τ units) Night, ice	(TBD)
1.4.6-5	e. Measurement Accuracy	0.28 (τ units) Day, water, OD$\leq$1 0.08 (τ units) Day, ice, OD$\leq$1 0.16 (τ units) Night, ice, OD$\leq$1 10% Day, water, OD>1 5% Day, ice, OD>1 10% Night, Ice, OD>1	5 %
1.4.6-6	f. Measurement Precision	0.1 (τ units) Day, water, OD$\leq$1 0.023 (τ units) Day, ice, OD$\leq$1 0.025 (τ units) Night, ice, OD$\leq$1 4 % Day, water, OD>1 3 % Day, ice OD>1 5 % Night, ice OD>1	Greater of 2 % or (TBD)
1.4.6-7	g. Long Term Stability	2 %	1 %
1.4.6-8	h. Mapping Uncertainty	1.5 km	1 km
1.4.6-9	i. Max Local Average Revisit Time (S)	8 hrs	3 hrs
1.4.6-10	j. Deleted.		
1.4.6-12	k. Latency (S)	90 minutes	15 minutes
1.4.6-13	l. Fine Measurement Uncertainty	0.3 (τ units) Day, water, OD$\leq$1 0.1 (τ units) Day, ice, OD$\leq$1 0.16 (τ units) Night, ice, OD$\leq$1 10% Day, water, OD>1 10% Day, ice, OD>1	

		10% Night, Ice, OD>1	

1.4.7 Cloud Top Height

Cloud top height is defined for each cloud-covered earth location as the set of heights of the tops of the cloud layers overlying the location. The reported heights are horizontal spatial averages over a cell, i.e., a square region of the earth's surface. If a cloud layer does not extend over an entire cell, the spatial average is limited to the portion of the cell that is covered by the layer. Cloud top height is not defined or reported for cells that are clear. As a threshold, the height at the top of up to four cloud layers is required. The objective is to report the cloud top height for all distinct cloud layers.

Units: km

Para. No.		Threshold	Objectives
	a. Horizontal Cell Size		
1.4.7-1	1. Moderate	25 km	1 km
1.4.7-13	2. Fine, nadir	5 km	1 km
1.4.7-2	b. Horizontal Reporting Interval	HCS	(TBD)
1.4.7-3	c. Horizontal Coverage	Global	Global
	d. Vertical Cell Size	N/A	N/A
1.4.7-4	e. Vertical Reporting Interval	Up to 4 layers	Top of all distinct cloud layers
1.4.7-5	f. Measurement Range	0-20 km	(TBD)
	g. Measurement Accuracy		
1.4.7-6	1. Cloud layer optical thickness > 0.1 (TBR)	0.5 km Day, water, OT>1 1 km Night, water OT>1 1 km Ice OT>1	0.3 km
1.4.7-7	2. Cloud layer optical thickness ≤ 0.1 (TBR)	2 km OT ≤ 1	0.3 km
1.4.7-8	h. Measurement Precision	0.3 km	0.15 km
1.4.7-9	i. Long Term Stability	0.2 km	0.1 km
1.4.7-10	j. Mapping Uncertainty	1.5 km	1 km
1.4.7-11	k. Maximum Local Average Revisit Time (S)	6 hrs	4 hrs
1.4.7-12	l. Deleted.		
1.4.7-14	m. Latency (S)	90 minutes	15 minutes
1.4.7-15	n. Fine, Measurement Uncertainty	0.5 km Day, water, OT>1 1 km Night, water OT>1 2 km Day, night, water 1 km Ice	

1.4.8 Cloud Top Pressure

Cloud top pressure is defined for each cloud-covered earth location as the set of atmospheric pressures at the tops of the cloud layers overlying the location. The reported pressures are horizontal spatial averages over a cell, i.e., a square region of the earth's surface. If a cloud layer does not extend over an entire cell, the spatial average is limited to the portion of the cell that is covered by the layer. Cloud top pressure is not defined or reported for cells that are clear. As a threshold, only the pressure at the top of the highest altitude cloud layer is required. The objective is to report the cloud top pressure for all distinct cloud layers.

Units: mb

Para. No.		Threshold	Objectives
	a. Horizontal Cell Size		
1.4.8-1	1. Moderate	12.5 km	1 km
1.4.8-17	2. Fine, nadir	5 km	1 km
1.4.8-2	b. Horizontal Reporting Interval	HCS	(TBD)
1.4.8-3	c. Horizontal Coverage	Global	Global
1.4.8-4	d. Measurement Range	50 to 1050 mb	(TBD)
	e. Measurement Accuracy		
1.4.8-5	1. [Surface – 3 km]	100 mb OT≤1, day/night, water 40 mb OT> 1 day, water 70 mb OT>1 night, water	30 mb
1.4.8-6	2. [3 – 7 km]	65 mb OT ≤ 1 40 mb OT> 1	22 mb
1.4.8-7	3. [> 7 km]	30 mb	15 mb
	f. Measurement Precision		
1.4.8-8	1. [Surface – 3 km]	25 mb	10 mb
1.4.8-9	2. [3 – 7 km]	20 mb	7 mb
1.4.8-10	3. [> 7 km]	13 mb	5 mb
	g. Long Term Stability (TBR)		
1.4.8-11	1. [Surface – 3 km]	10 mb	3 mb
1.4.8-12	2. [3 – 7 km]	7 mb	2 mb
1.4.8-13	3. [> 7 km]	5 mb	1 mb
1.4.8-14	h. Mapping Uncertainty	1.5 km	1 km
1.4.8-15	i. Maximum Local Average Revisit Time (S)	8 hrs	3 hrs
1.4.8-16	j. Deleted.		
1.4.8-18	k. Latency (S)	90 minutes	15 minutes
	l. Fine Measurement Uncertainty		
1.4.8-19	1. [Surface to 3 km]	130 mb OT≤1, day, water 100 mb OT<1 night, water 40 mb OT> 1 day, water 80 mb OT>1 night, water	
1.4.8-20	2. [3 – 7 km]	70 mb OT ≤ 1 45 mb OT > 1	
1.4.8-21	3. [> 7 km]	30 mb	

1.4.9 Cloud Top Temperature

Cloud top temperature is defined for each cloud-covered earth location as the set of atmospheric temperatures at the tops of the cloud layers overlying the location. The reported temperatures are horizontal spatial averages over a cell, i.e., a square region of the earth's surface. If a cloud layer does not extend over an entire cell, the spatial average is limited to the portion of the cell that is covered by the layer. Cloud top temperature is not defined or reported for cells that are clear. As a threshold, only the temperature at the top of the highest altitude cloud layer is required. The objective is to report the cloud top temperature for all distinct cloud layers.

Units: K

Para. No.		Threshold	Objectives
	a. Horizontal Cell Size		
1.4.9-1	1. Moderate	25 km	1 km
1.4.9-12	2. Fine, nadir	5 km	1 km
1.4.9-2	b. Horizontal Reporting Interval	HCS	(TBD)
1.4.9-3	c. Horizontal Coverage	Global	Global
1.4.9-4	d. Measurement Range	175 to 310 K	(TBD)
	e. Measurement Accuracy		
1.4.9-5	1. Cloud layer optical thickness > 0.1 (TBR)	2 K OT>1, Water cloud, Day 3 K OT>1, Water cloud, Night 3 K OT>1, Ice Cloud	1.5 K
1.4.9-6	2. Cloud layer optical thickness ≤ 0.1 (TBR)	6 K OT < 1	(TBD)
1.4.9-7	f. Measurement Precision	1.5 K	0.5 K
1.4.9-8	g. Long Term Stability	1 K	0.1 K
1.4.9-9	h. Mapping Uncertainty	1.5 km	1 km
1.4.9-10	i. Maximum Local Average Revisit Time (S)	6 hrs	6 hrs
1.4.9-11	j. Deleted.		
1.4.9-13	k. Latency (S)	90 minutes	15 minutes
1.4.9-14	l. Fine Measurement Uncertainty	3 K Water 5 K Ice	

1.5 Earth Radiation Budget EDRs

All requirements for Earth Radiation Budget EDRs below apply under both clear and cloudy conditions except for the Surface Albedo.

1.5.2 Albedo (Surface)

Surface albedo is defined as the total amount of solar radiation in the 0.4 to 4.0 micron band reflected by the Earth's surface into an upward hemisphere (sky dome), including both diffuse and direct components, divided by the total amount incident from this hemisphere, including both direct and diffuse components. This EDR is required during daytime only and under clear conditions only. This is an instantaneous, not a time-averaged, measurement.

Units: Dimensionless

Para. No.		Threshold	Objectives
1.5.2-1	a. Horizontal Cell Size	1.6 km (Mod, EOS) 0.75 km (Fine, nadir)	0.5 km
1.5.2-2	b. Horizontal Reporting Interval	HCS	(TBD)
1.5.2-3	c. Horizontal Coverage	Global	Global
1.5.2-4	d. Measurement Range	0 – 1.0 units of albedo	0 – 1.0
1.5.2-5	e. Measurement Accuracy	0.025 units of albedo	0.0125
1.5.2-6	f. Measurement Precision	0.02 units of albedo	0.01
1.5.2-7	g. Long Term Stability	0.01 units of albedo	0.01
1.5.2-8	h. Mapping Uncertainty	1.5 km	1.0 km
1.5.2-9	i. Max Local Average Revisit Time (S)	24 hrs	4 hrs
1.5.2-10	j. Deleted.		
1.5.2-11	k. Latency (S)	150 minutes	60 minutes
1.5.2-12	l. Fine Measurement Uncertainty	0.03 units of albedo	

1.6 Land EDRs

1.6.1 Land Surface Temperature

Land surface temperature (LST) is defined as the skin temperature of the uppermost layer of the land surface. This EDR is required under clear conditions only.

Units: K

Para. No.		Threshold	Objectives
1.6.1-1	a. Horizontal Cell Size	0.75 km (nadir) 1.3 km (EOS)	1 km
1.6.1-2	b. Horizontal Reporting Interval	HCS	(TBD)
1.6.1-3	c. Horizontal Coverage	Land	Land
1.6.1-4	d. Measurement Range	213 K – 343 K	183 K – 343 K
1.6.1-5	e. Measurement Accuracy	2.4 K	1 K
1.6.1-6	f. Measurement Precision	0.5 K	0.025 K
1.6.1-7	g. Mapping Uncertainty	1.5 km	1 km
1.6.1-8	h. Max Local Average Revisit Time (S)	6 hrs	3 hrs
1.6.1-9	i. Deleted.		
1.6.1-10	j. Latency (S)	90 minutes	15 minutes
1.6.1-11	k. Measurement Uncertainty, Nadir	2.50 K	

1.6.2 Vegetation Index

Normalized difference vegetation index (Top of the Atmosphere) is most directly related to absorption of photosynthetically active radiation, but is often correlated with biomass or primary productivity. Red spectral measurements are sensitive to the chlorophyll content of vegetation and the near IR to the mesophyll structure of leaves. The normalized ratio (IR-Red)/(IR+ Red) has a close relationship with the photosynthetic capacity of specific vegetation types.

The NASA/NOAA NDVI (for AVHRR-3) is defined as follows:

NDVI = RATIO of [(Reflectance band 2 – reflectance band 1)/ sum],
where: Band 2 = NIR band (0.72-1.0 microns);
Band 1 = VIS band (0.572-0.703 microns).

These specific spectral ranges are not required.
This product also contains a Top of the Canopy Enhanced Vegetation Index (EVI) which is defined as an index using three or more bands and of an appropriate derived functional form designed to be more robust than NDVI under variations in atmospheric conditions and soil properties. The requirements below apply only under clear, daytime conditions.

Units: Dimensionless

Para. No.		Threshold	Objectives
1.6.2-1	a. Horizontal Cell Size	0.8 km (Mod, EOS) 0.375 km (Fine, nadir)	1 km
1.6.2-2	b. Horizontal Reporting Interval	HCS	(TBD)
1.6.2-3	c. Horizontal Coverage	Land	(TBD)
1.6.2-4	d. Measurement Range	-1 to +1 NDVI units -1 to +1 EVI units	-1 to +1 NDVI units
1.6.2-5	e. Measurement Accuracy	0.016 NDVI units (Mod)	0.03 NDVI units
1.6.2-6	f. Measurement Precision	0.02 NDVI units (Mod)	0.02 NDVI units
1.6.2-7	g. Long Term Stability	0.01 NDVI units	0.04 NDVI units
1.6.2-8	h. Mapping Uncertainty	1.5 km EOS; 0.4 km (nadir)	1 km
1.6.2-9	i. Max Local Average Revisit Time (S)	24 hrs	24 hrs
1.6.2-10	j. Deleted.		
1.6.2-11	k. Measurement Uncertainty for EVI	0.11 units of EVI	
1.6.2-12	l. Long Term Stability (C)	0.04 NDVI units	0.04 NDVI units
1.6.2-13	m. Latency (S)	90 minutes	15 minutes
1.6.2-14	n. Fine Measurement Uncertainty, NDVI	0.020 NDVI units	

1.6.3 Snow Cover/Depth

Horizontal and vertical extent of snow cover. As a threshold, only fraction of snow cover in the specified horizontal cell (clear or cloudy) is required, regardless of depth. As an objective, fraction of snow cover for snow having a specified minimum depth is required in the specified horizontal cell for a set of specified minimum depths. In addition, a binary product will give a snow/no snow flag.

Para. No.		Threshold	Objectives
	a. Horizontal Cell Size		
1.6.3-1	1.Clear	0.8 km (nadir) 1.6 km (EOS)	1 km
1.6.3-2	2. All weather and/or nighttime	12.5 km.	1 km
1.6.3-3	b. Horizontal Reporting Interval	HCS	1 km
1.6.3-4	c. Snow Depth Ranges	Snow/No snow	> 8 cm, > 15 cm, > 30 cm, >51 cm, >76 cm
1.6.3-5	d. Horizontal Coverage	Land Snow/No snow	Land & Ice
1.6.3-6	e. Vertical Coverage	Land	0 – 1 m
1.6.3-7	f. Measurement Range	0 – 1 HCS	0 – 1 per snow depth category
	g. Measurement Uncertainty		
1.6.3-8	1.. Clear – daytime	10 % (snow/no snow)	10 % for snow depth
1.6.3-9	2. Cloudy and/or nighttime	20 % (snow/no snow)	10 %
	h. Mapping Uncertainty		
1.6.3-10	1. Clear	1.5 km (EOS)	1 km
1.6.3-11	2. Cloudy	3 km (EOS)	1 km
1.6.3-12	i. Max Local Average Revisit Time (S)	12 hrs	3 hrs
1.6.3-13	j. Deleted.		
1.6.3-14	k. Binary HCS	Clear, day, nadir 0.4 km Clear, day, EOS 0.8 km	
1.6.3-15	l. Sensing Depth (all weather)	0 to 40 cm	1 m
1.6.3-16	m. Long Term Stability (C)	10 %	1% continental
1.6.3-17	n. Latency (S)	90 minutes	15 minutes
1.6.3-18	o. Binary Map- Measurement Range	Snow/No Snow	
1.6.3-19	p. Binary Map- Probability of Correct Typing	95%	

1.6.4 Surface Type

Surface type is defined as one of the seventeen International Geosphere Biosphere Program (IGBP) classes defined below. Estimation of the percentage of vegetation cover per type in each cell is an objective. The requirements below apply in both clear and cloudy conditions. Each given area shall be classified as one of the following types:

Land Cover Class	Definition
1. Evergreen Needleleaf Forests	Lands dominated by woody vegetation with a percent cover >60% and height exceeding 2 meters. Almost all trees remain green all year. Canopy is never without green foliage.
2. Deciduous Needleleaf Forests	Lands dominated by woody vegetation with a percent cover >60% and height exceeding 2 meters. Consists of seasonal, needleleaf tree communities with an annual cycle of leaf-on and leaf-off periods.
3. Evergreen Broadleaf Forests	Lands dominated by woody vegetation with a percent cover >60% and height exceeding 2 meters. Almost all trees and shrubs remain green all year. Canopy is never without green foliage.
4. Deciduous Broadleaf Forests	Lands dominated by woody vegetation with a percent cover >60% and height exceeding 2 meters. Consists of broadleaf tree communities with an annual cycle of leaf-on and leaf-off periods.
5. Mixed Forests	Lands dominated by woody vegetation with a percent cover >60% and height exceeding 2 meters. Consists of tree communities with interspersed mixtures or mosaics of the other four forest types. None of the forest types exceeds 60% of landscape.
6. Closed Shrublands	Lands with woody vegetation less than 2 meters tall and with shrub canopy cover >60%. The shrub foliage can be either evergreen or deciduous.
7. Open Shrublands	Lands with woody vegetation less than 2 meters tall and with shrub canopy cover between 10-60%. The shrub foliage can be either evergreen or deciduous.
8. Woody Savannas	Lands with herbaceous and other understory systems, and with forest canopy cover between 30-60%. The forest cover height exceeds 2 meters.
9. Savannas	Lands with herbaceous and other understory systems, and with forest canopy cover between 10-30%. The forest cover height exceeds 2 meters.
10. Grasslands	Lands with herbaceous types of cover. Tree and shrub cover is less than 10%.
11. Permanent Wetlands	Lands with a permanent mixture of water and herbaceous or woody vegetation. The vegetation can be present in either salt, brackish, or fresh water.
12. Croplands	Lands covered with temporary crops followed by harvest and a bare soil period (e.g., single and multiple cropping systems). Note than perennial woody crops will be classified as the appropriate forest or shrubland cover type.
13. Urban and Built-Up	Land covered by buildings and other man-made structures.
14. Cropland/Natural Vegetation Mosaics	Lands with a mosaic of croplands, forests, shrubland, and grasslands in which no one component comprises more than 60% of the landscape.
15. Snow and Ice	Lands under snow/ice cover.
16. Barren	Lands with exposed soil, sand, rocks, or snow and never have more than 10% vegetated cover during any time of the year.
17. Water Bodies	Oceans, seas, lakes, reservoirs, and rivers. Can be either fresh or salt-water bodies.

Units:
Type: N/A
Vegetation Cover: per cent

Para. No.		Threshold	Objectives
1.6.4-1	a. Horizontal Cell Size	1 km	0.25 km
1.6.4-2	Deleted		
1.6.4-3	b. Horizontal Reporting Interval	HCS	(TBD)
1.6.4-4	c. Horizontal Coverage	Land	Land
1.6.4-5	Deleted		
	d. Measurement Range		
1.6.4-6	1. Vegetation/surface type	17 Types (Specified above)	17 Types (Specified above)
1.6.4-7	2. Vegetation cover	0 – 100 %	0 – 100 %
1.6.4-8	e. Measurement Accuracy (veg. cover)	2 0%	2 %
1.6.4-9	f. Measurement Precision (veg. cover)	10 %	0.1 %
1.6.4-10	g. Correct Typing Probability (vegetation /surface type)	88 %	98 %
1.6.4-11	h. Mapping Uncertainty	1.5 km	1 km
1.6.4-12	i. Max Local Average Revisit Time (S)	24 hrs	3 hrs
1.6.4-13	j. Deleted.		
1.6.4-14	k. Latency (S)	90 minutes	15 minutes

1.6.4.1 **Active Fires (Application of Surface Type EDR)**

Active surface fires are natural or anthropogenic fires. This application of the Surface Type EDR provides (a) geolocation of the pixels in which active fires are detected, (b) the sub-pixel average temperature of each active fire, and (c) the sub-pixel area of each active fire. The number of bands for which these products are provided is algorithm dependent and therefore TBD. A global, binary "fire/no fire" map is neither required nor desired. The products for this application are desired during both day and night time for clear-sky conditions and within clear areas under conditions of broken clouds.

Units: Degrees latitude and longitude for geolocation, K for sub-pixel average temperature, m^2 for active fire area.

Para. No.		Thresholds	Objectives
	a. Horizontal Cell Size		
1.6.4.1-1	1. At nadir	0.75 km	0.5 km
1.6.4.1-2	2. Worst case	1.6 km	0.5 km
1.6.4.1-3	b. Horizontal Reporting Interval	HCS	(TBD)
1.6.4.1-4	c. Horizontal Coverage	Land	Land
	d. Measurement Range:		
1.6.4.1-5	1. Sub-pixel average temperature of active fire	800 K – 1200 K	800 K – 1200 K
1.6.4.1-6	2. Sub-pixel area of active fire	from 1000 m^2 to 50 m times ground sample distance in scan direction (TBR)	from $(50\ m)^2$ to 100 m by greater of pixel in-scan and in-track dimensions (TBR).
	e. Measurement Uncertainty		
1.6.4.1-7	1. Sub-pixel average temperature of active fire	50 K	25 K
1.6.4.1-8	2. Sub-pixel area of active fire	30%	15%
1.6.4.1-9	f. Mapping Uncertainty	0.4km	0.1 km
1.6.4.1-11	g. Maximum Local Average Revisit Time (S)	6 hrs	1 hour
1.6.4.1-12	h. Deleted.		
1.6.4.1-10	i. Deleted		
1.6.4.1-13	j. Latency (S)	90 minutes	15 minutes

1.7 Ocean/Water EDRs

1.7.3 Ice Surface Temperature

As a threshold, the temperature of the surface of ice over land or water is required. The objective is to measure the atmospheric temperature 2 m above the surface of the ice. This EDR is required under clear conditions only.
Units: K

Para. No.		Threshold	Objectives
	a. Horizontal Cell Size		
1.7.3-1	1. Nadir	1.0 km	0.1 km
1.7.3-9	2. Worst case	1.6 km	0.1 km
1.7.3-2	b. Horizontal Reporting Interval	1.0 km	0.1 km
1.7.3-3	c. Horizontal Coverage	Ice-covered land/water	Ice-covered land/water
1.7.3-4	d. Measurement Range	213 K – 275 K	213 K – 293 K (2 m above ice)
1.7.3-5	e. Measurement Uncertainty	0.5 K	(TBD)
1.7.3-6	f. Mapping Uncertainty, nadir	0.4 km	0.1 km
1.7.3-7	g. Maximum Local Average Revisit Time (S)	24 hrs	12 hrs
1.7.3-8	h. Deleted.		
1.7.3-10	i. Latency (S)	90 minutes	15 minutes

1.7.5 Net Heat Flux

Net heat flux refers to net surface flux over oceans (including ice covered). Components are long-wave and short-wave radiation, latent heat flux and sensible heat flux. The requirements below apply under clear conditions only.

Units: W/m^2

Para. No.		Threshold	Objectives
1.7.5-1	a. Horizontal Cell Size	20 km	5 km
1.7.5-2	b. Horizontal Reporting Interval	HCS	(TBD)
1.7.5-3	c. Horizontal Coverage	Oceans	Global Oceans
1.7.5-4	d. Measurement Range	0 – 2000 W/m^2	0 – 2000 W/m^2
1.7.5-5	e. Measurement Accuracy	10 W/m^2	1 W/m^2
1.7.5-6	f. Measurement Precision	25 W/m^2	1 W/m^2
1.7.5-7	g. Mapping Uncertainty	1.5 km	(TBD)
1.7.5-8	h. Maximum Local Average Revisit Time (S)	6 hrs	3 hrs
1.7.5-9	i. Deleted.		
1.7.5-10	j. Latency (S)	24 hours	6 hours

1.7.6 Ocean Color/Chlorophyll

Ocean color is defined as the spectrum of water-leaving radiances (L_w), i.e. the portion of the visible-near infrared light that is reflected at the surface. All geophysical quantities of interest, e.g., the concentration of phytoplankton pigment chlorophyll α (chlorophyll-α) and the inherent optical properties of absorption and scattering of surface waters (ocean optical properties), are derived from these L_w values. Water leaving radiances are measured in mW cm^{-2} μm^{-1} sr^{-1}. Ocean optical properties, absorption, and scattering are estimated at each measured visible wavelength, and have units of m^{-1} while chlorophyll-α is measured in mg m^{-3}. This EDR is required under clear, daytime conditions only.

Units:

Ocean Color : W m^{-2} μm^{-1} sr^{-1}

Ocean Optical Properties: m^{-1}

Chlorophyll: mg m^{-3}

Para. No.		Threshold	Objectives
	a. Horizontal Cell Size		
1.7.6-1	1. Worst case	1.6 km	0.1 km
1.7.6-2	2. Nadir	0.75 km	0.1 km
1.7.6-3	b. Horizontal Reporting Interval	HCS	HCS
1.7.6.7-29	c. Horizontal Coverage	Oceans	Oceans
1.7.6-4	Deleted		
1.7.6-5	Deleted		
	d. Measurement Range		
1.7.6-13	1. Ocean Color	1.0 – 10 W m^{-2} μm^{-1} sr^{-1}	0. 05-10 W m^{-2} μm^{-1} sr^{-1}
	2. Optical Properties		
1.7.6-14	a. Absorption	0.01 – 10 m^{-1}	0.005 – 20 m^{-1}
1.7.6-15	b. Scattering	0.01 – 50 m^{-1}	0.005 – 75 m^{-1}
1.7.6-16	c. Chlorophyll Fluorescence	N/A	Detectable signals in waters with chlorophyll from 0.1 to 50 mg m^{-3} at 1 km resolution.
1.7.6-6	3. Chlorophyll	0.05 – 50 mg/m^3	0.001 – 100 mg/m^3
	e. Measurement Accuracy		
	1. Ocean Color		
1.7.6-17	a. Operational	10 %	5 %
1.7.6-18	b. Deleted.		
	2. Optical Properties		
1.7.6-19	a. Operational	40 %	30 %
1.7.6-20	b. Deleted.		
	3. Chlorophyll		
1.7.6-7	a. Operational	15% Chl <1.0 mg/m^3 30% 1.0 <Chl <10 mg/m^3 50% Chl >10 mg/m^3	20 %
1.7.6-21	b. Deleted.		

	f. Measurement Precision		
	1. Ocean Color		
1.7.6-22	a. Operational	5 %	2 %
1.7.6-23	b. Deleted.		
	2. Optical Properties		
1.7.6-24	a. Operational	20 %	20 %
1.7.6-25	b. Deleted.		
	3. Chlorophyll		
1.7.6-8	a. Operational	20% Chl <1.0 mg/m^3 30% 1.0 <Chl <10 mg/m^3 50% Chl >10 mg/m^3	10 %
	g. Mapping Uncertainty		
1.7.6-9	1. Worst Case	0.8 km (intermediate swath)	0.1 km
1.7.6-10	2. Nadir	0.4 km	0.1 km
1.7.6-11	h. Max Local Average Revisit Time (S)	24 hrs	12 hrs
1.7.6-12	i. Deleted.		
1.7.6-26	j. Long Term Stability ($W\ m^{-2}\ \mu m^{-1}\ sr^{-1}$) (C) SEE NOTE 1	Max Chl Absorption 0.5 Min Chl Absorption 0.25 Atmospheric Correction 0.08	Max Chl Absorption 0.25 Min Chl Absorption 0.125 Atmospheric correction 0.04
	k. Latency (S)		
1.7.6-27	1. Operational	180 minutes	60 minutes
1.7.6-28	2. Deleted.		

Note 1: Stability is for water leaving radiance at the band of Maximum Chlorophyll absorption (measured at approximately 445 nm), Min Chlorophyll Absorption (at approximately 555 nm), and Atmospheric Correction (at approximately 865 nm).

1.7.8 Sea Ice Characterization

Sea ice age is defined as the time that has passed since the formation of the surface layer of an ice covered region of the ocean. The content of the sea ice age EDR is the typing of areas of sea ice by age. The requirements below apply under all weather conditions.

Units:
Ice age: WMO Nomenclature Class
Ice edge Concentration: Tenths

Para. No.		Threshold	Objectives
1.7.8-1	a. Horizontal Cell Size (Ice Age)		
	Clear	2.4 km	0.1 km
	All Weather	20 km	0.05 km
1.7.8-2	b. Horizontal Reporting Interval	HCS	HCS
1.7.8-3	c. Horizontal Coverage	Oceans	All ice covered regions of the global ocean
	d. Measurement Range		
1.7.8-4	1. Ice Age Classes	New/Young, First Year, Multi-year	Ice free, Nilas, GreyWhite, Grey, White, First Year Medium, First Year thick, Second Year, and Multiyear; Smooth and Deformed Ice
1.7.8-5	2. Ice Concentration	1/10 to 10/10	0/10 to 10/10
1.7.8-6	e. Probability of Correct Typing (Ice Age)	80% (First year from Multi-year) 70% (New/Young from First year) 70% (New/Young from Multi-year)	90 %
1.7.8-7	f. Measurement Uncertainty (Ice Concentration)	1/10	5 %
1.7.8-8	g. Mapping Uncertainty	1.5 km	0.05 km
1.7.8-9	h. Max Local Average Revisit Time (S)	24 hrs	6 hrs
1.7.8-10	i. Deleted.		
1.7.8-11	j. Long Term Stability (C)	1 % concentration	
1.7.8-12	k. Latency (S)	8 hrs	15 minutes

APPENDIX B

INSTRUCTIONS FOR RESPONDING TO NASA RESEARCH ANNOUNCEMENTS

NASA Federal Acquisition Regulation (FAR), Supplement (NFS) Part 1852.235-72 , Effective JANUARY 2000 (Modified)

(a) General.

(1) Proposals received in response to a NASA Research Announcement (NRA) will be used only for evaluation purposes. NASA does not allow a proposal, the contents of which are not available without restriction from another source, or any unique ideas submitted in response to an NRA to be used as the basis of a solicitation or in negotiation with other organizations, nor is a pre-award synopsis published for individual proposals.

(2) A solicited proposal that results in a NASA award becomes part of the record of that transaction and may be available to the public on specific request; however, information or material that NASA and the awardee mutually agree to be of a privileged nature will be held in confidence to the extent permitted by law, including the Freedom of Information Act.

(3) NRAs contain programmatic information and certain requirements which apply only to proposals prepared in response to that particular announcement. These instructions contain the general proposal preparation information which applies to responses to all NRAs.

(4) A contract, grant, cooperative agreement, or other agreement may be used to accomplish an effort funded in response to an NRA. NASA will determine the appropriate instrument. Contracts resulting from NRAs are subject to the Federal Acquisition Regulation and the NASA FAR Supplement. Any resultant grants or cooperative agreements will be awarded and administered in accordance with the NASA Grant and Cooperative Agreement Handbook (NPG 5800.1).

(5) NASA does not have mandatory forms or formats for responses to NRAs; however, it is requested that proposals conform to the guidelines in these instructions. NASA may accept proposals without discussion; hence, proposals should initially be as complete as possible and be submitted on the proposers' most favorable terms.

(6) To be considered for award, a submission must, at a minimum, present a specific project within the areas delineated by the NRA; contain sufficient technical and cost information to permit a meaningful evaluation; be signed by an official authorized to legally bind the submitting organization; not merely offer to perform standard services or to just provide computer facilities or services; and not significantly duplicate a more specific current or pending NASA solicitation.

(b) NRA-Specific Items. Several proposal submission items appear in the NRA itself: the unique NRA identifier; when to submit proposals; where to send proposals; number of copies required; and sources for more information. Items included in these instructions may be supplemented by the NRA.

(c) The following information is needed to permit consideration in an objective manner. NRAs will generally specify topics for which additional information or greater detail is desirable. Each proposal copy shall contain all submitted material, including a copy of the transmittal letter if it contains substantive information.

(1) Transmittal Letter or Prefatory Material.

(i) The legal name and address of the organization and specific division or campus identification if part of a larger organization;

(ii) A brief, scientifically valid project title intelligible to a scientifically literate reader and suitable for use in the public press;
(iii) Type of organization: e.g., profit, nonprofit, educational, small business, minority, women-owned, etc.;
(iv) Name and telephone number of the principal investigator and business personnel who may be contacted during evaluation or negotiation;
(v) Identification of other organizations that are currently evaluating a proposal for the same efforts;
(vi) Identification of the NRA, by number and title, to which the proposal is responding;
(vii) Dollar amount requested, desired starting date, and duration of project;
(viii) Date of submission; and
(ix) Signature of a responsible official or authorized representative of the organization, or any other person authorized to legally bind the organization (unless the signature appears on the proposal itself).

(2) Restriction on Use and Disclosure of Proposal Information**.** Information contained in proposals is used for evaluation purposes only. Offerors or quoters should, in order to maximize protection of trade secrets or other information that is confidential or privileged, place the following notice on the title page of the proposal and specify the information subject to the notice by inserting an appropriate identification in the notice. In any event, information contained in proposals will be protected to the extent permitted by law, but NASA assumes no liability for use and disclosure of information not made subject to the notice.

Notice
Restriction on Use and Disclosure of Proposal Information

The information (data) contained in *[insert page numbers or other identification]* of this proposal constitutes a trade secret and/or information that is commercial or financial and confidential or privileged. It is furnished to the Government in confidence with the understanding that it will not, without permission of the offeror, be used or disclosed other than for evaluation purposes; provided, however, that in the event a contract (or other agreement) is awarded on the basis of this proposal the Government shall have the right to use and disclose this information (data) to the extent provided in the contract (or other agreement). This restriction does not limit the Government's right to use or disclose this information (data) if obtained from another source without restriction.

(3) Abstract**.** Include a concise (200-300 word if not otherwise specified in the NRA) abstract describing the objective and the method of approach.

(4) Project Description.

(i) The main body of the proposal shall be a detailed statement of the work to be undertaken and should include objectives and expected significance; relation to the present state of knowledge; and relation to previous work done on the project and to related work in progress elsewhere. The statement should outline the plan of work, including the broad design of experiments to be undertaken and a description of experimental methods and procedures. The project description should address the evaluation factors in these instructions and any specific factors in the NRA. Any substantial collaboration with individuals not referred to in the budget or use of consultants should be described. Subcontracting significant portions of a research project is discouraged.

(ii) When it is expected that the effort will require more than one year, the proposal should cover the complete project to the extent that it can be reasonably anticipated. Principal emphasis should be on the first year of work, and the description should distinguish clearly between the first year's work and work planned for subsequent years.

(5) Management Approach. For large or complex efforts involving interactions among numerous individuals or other organizations, plans for distribution of responsibilities and arrangements for ensuring a coordinated effort should be described.

(6) Personnel. The principal investigator is responsible for supervision of the work and participates in the conduct of the research regardless of whether or not compensated under the award. A short biographical sketch of the principal investigator, a list of principal publications and any exceptional qualifications should be included. Omit social security number and other personal items which do not merit consideration in evaluation of the proposal. Give similar biographical information on other senior professional personnel who will be directly associated with the project. Give the names and titles of any other scientists and technical personnel associated substantially with the project in an advisory capacity. Universities should list the approximate number of students or other assistants, together with information as to their level of academic attainment. Any special industry-university cooperative arrangements should be described.

(7) Facilities and Equipment.

(i) Describe available facilities and major items of equipment especially adapted or suited to the proposed project, and any additional major equipment that will be required. Identify any Government-owned facilities, industrial plant equipment, or special tooling that are proposed for use. Include evidence of its availability and the cognizant Government points of contact.

(ii) Before requesting a major item of capital equipment, the proposer should determine if sharing or loan of equipment already within the organization is a feasible alternative. Where such arrangements cannot be made, the proposal should so state. The need for items that typically can be used for research and non-research purposes should be explained.

(8) Proposed Costs (U.S. Proposals Only).

(i) Proposals should contain cost and technical parts in one volume: do not use separate "confidential" salary pages. As applicable, include separate cost estimates for salaries and wages; fringe benefits; equipment; expendable materials and supplies; services; domestic and foreign travel; ADP expenses; publication or page charges; consultants; subcontracts; other miscellaneous identifiable direct costs; and indirect costs. List salaries and wages in appropriate organizational categories (e.g., principal investigator, other scientific and engineering professionals, graduate students, research assistants, and technicians and other non-professional personnel). Estimate all staffing data in terms of staff-months or fractions of full-time.

(ii) Explanatory notes should accompany the cost proposal to provide identification and estimated cost of major capital equipment items to be acquired; purpose and estimated number and lengths of trips planned; basis for indirect cost computation (including date of most recent negotiation and cognizant agency); and clarification of other items in the cost proposal that are not self-evident. List estimated expenses as yearly requirements by major work phases.

(iii) Allowable costs are governed by FAR Part 31 and the NASA FAR Supplement Part 1831 (and OMB Circulars A-21 for educational institutions and A-122 for nonprofit organizations).

(iv) Use of NASA funds--NASA funding may not be used for foreign research efforts at any level, whether as a collaborator or a subcontract. The direct purchase of supplies and/or services, which do not constitute research, from non-U.S. sources by U.S. award recipients is permitted. Additionally, in accordance with the National Space Transportation Policy, use of a non-U.S. manufactured launch vehicle is permitted only on a no-exchange-of-funds basis.

(9) Security. Proposals should not contain security classified material. If the research requires access to or may generate security classified information, the submitter will be required to comply with Government security regulations.

(10) Current Support. For other current projects being conducted by the principal investigator, provide title of project, sponsoring agency, and ending date.

(11) Special Matters.

(i) Include any required statements of environmental impact of the research, human subject or animal care provisions, conflict of interest, or on such other topics as may be required by the nature of the effort and current statutes, executive orders, or other current Government-wide guidelines.

(ii) Proposers should include a brief description of the organization, its facilities, and previous work experience in the field of the proposal. Identify the cognizant Government audit agency, inspection agency, and administrative contracting officer, when applicable.

(d) Renewal Proposals.

(1) Renewal proposals for existing awards will be considered in the same manner as proposals for new endeavors. A renewal proposal should not repeat all of the information that was in the original proposal. The renewal proposal should refer to its predecessor, update the parts that are no longer current, and indicate what elements of the research are expected to be covered during the period for which support is desired. A description of any significant findings since the most recent progress report should be included. The renewal proposal should treat, in reasonable detail, the plans for the next period, contain a cost estimate, and otherwise adhere to these instructions.

(2) NASA may renew an effort either through amendment of an existing contract or by a new award.

(e) Length. Unless otherwise specified in the NRA, effort should be made to keep proposals as brief as possible, concentrating on substantive material. Few proposals need exceed 15-20 pages. Necessary detailed information, such as reprints, should be included as attachments. A complete set of attachments is necessary for each copy of the proposal. As proposals are not returned, avoid use of "one-of-a-kind" attachments.

(f) Joint Proposals.

(1) Where multiple organizations are involved, the proposal may be submitted by only one of them. It should clearly describe the role to be played by the other organizations and indicate the legal and managerial arrangements contemplated. In other instances, simultaneous submission of related proposals from each organization might be appropriate, in which case parallel awards would be made.

(2) Where a project of a cooperative nature with NASA is contemplated, describe the contributions expected from any participating NASA investigator and agency facilities or equipment which may be required. The proposal must be confined only to that which the proposing organization can commit itself. "Joint" proposals which specify the internal arrangements NASA will actually make are not acceptable as a means of establishing an agency commitment.

(g) Late Proposals. Proposals or proposal modifications received after the latest date specified for receipt may be considered if a significant reduction in cost to the Government is probable or if there are significant technical advantages, as compared with proposals previously received.

(h) Withdrawal. Proposals may be withdrawn by the proposer at any time before award. Offerors are requested to notify NASA if the proposal is funded by another organization or of other changed circumstances which dictate termination of evaluation.

(i) Evaluation Factors.

(1) Unless otherwise specified in the NRA, the principal elements (of approximately equal weight) considered in evaluating a proposal are its relevance to NASA's objectives, intrinsic merit, and cost.

(2) Evaluation of a proposal's relevance to NASA's objectives includes the consideration of the potential contribution of the effort to NASA's mission.

(3) Evaluation of its intrinsic merit includes the consideration of the following factors of equal importance:

(i) Overall scientific or technical merit of the proposal or unique and innovative methods, approaches, or concepts demonstrated by the proposal.

(ii) Offeror's capabilities, related experience, facilities, techniques, or unique combinations of these which are integral factors for achieving the proposal objectives.

(iii) The qualifications, capabilities, and experience of the proposed principal investigator, team leader, or key personnel critical in achieving the proposal objectives.

(iv) Overall standing among similar proposals and/or evaluation against the state-of-the-art.

(4) Evaluation of the cost of a proposed effort may include the realism and reasonableness of the proposed cost and available funds.

(j) Evaluation Techniques. Selection decisions will be made following peer and/or scientific review of the proposals. Several evaluation techniques are regularly used within NASA. In all cases proposals are subject to scientific review by discipline specialists in the area of the proposal. Some proposals are reviewed entirely in-house, others are evaluated by a combination of in-house and selected external reviewers, while yet others are subject to the full external peer review technique (with due regard for conflict-of-interest and protection of proposal information), such as by mail or through assembled panels. The final decisions are made by a NASA selecting official. A proposal which is scientifically and programmatically meritorious, but not selected for award during its initial review, may be included in subsequent reviews unless the proposer requests otherwise.

(k) Selection for Award.

(1) When a proposal is not selected for award, the proposer will be notified. NASA will explain generally why the proposal was not selected. Proposers desiring additional information may contact the selecting official who will arrange a debriefing.

(2) When a proposal is selected for award, negotiation and award will be handled by the procurement office in the funding installation. The proposal is used as the basis for negotiation. The contracting officer may request certain business data and may forward a model award instrument and other information pertinent to negotiation.

(l) Additional Guidelines Applicable to Foreign Proposals and Proposals Including Foreign Participation.

(1) NASA welcomes proposals from outside the U.S. However, foreign entities are generally not eligible for funding from NASA. Therefore, unless otherwise noted in the NRA, proposals from foreign entities should not include a cost plan unless the proposal involves collaboration with a U.S. institution, in which case a cost plan for only the participation of the U.S. entity must be included. Proposals from foreign entities and proposals from U.S. entities that include foreign participation must be endorsed by the respective government agency or funding/sponsoring institution in the country from which the foreign entity is proposing. Such endorsement should indicate that the proposal merits careful consideration by NASA and, if the proposal is selected, sufficient funds will be made available to undertake the activity as proposed.

(2) All foreign proposals must be typewritten in English and comply with all other submission requirements stated in the NRA. All foreign proposals will undergo the same evaluation and selection process as those originating in the U.S. All proposals must be received before the established closing date. Those received after the closing date will be treated in accordance with paragraph (g) of this provision. Sponsoring foreign government agencies or funding institutions may, in exceptional situations, forward a proposal without endorsement if endorsement is not possible before the announced closing date. In such cases, the NASA sponsoring office should be advised when a decision on endorsement can be expected.

(3) Successful and unsuccessful foreign entities will be contacted directly by the NASA sponsoring office. Copies of these letters will be sent to the foreign sponsor. Should a foreign proposal or a U.S. proposal with foreign participation be selected, NASA's Office of External Relations will arrange with the foreign sponsor for the proposed participation on a no-exchange-of-funds basis, in which NASA and the non-U.S. sponsoring agency or funding institution will each bear the cost of discharging their respective responsibilities.

(4) Depending on the nature and extent of the proposed cooperation, these arrangements may entail:

(i) An exchange of letters between NASA and the foreign sponsor; or

(ii) A formal Agency-to-Agency Memorandum of Understanding (MOU).

(m) Export Control Guidelines Applicable to Foreign Proposals and Proposals Including Foreign Participation.

(1) U.S. proposals including foreign participation must include a section discussing compliance with U.S. export laws and regulations, e.g., 22 CFR Parts 120-130 and 15 CFR Parts 730-774, as applicable to the circumstances surrounding the particular foreign participation. The discussion must describe in detail the proposed foreign participation and is to include, but not limited to, whether or not the foreign participation may require the prospective proposer to obtain the prior approval of the Department of State or the Department of Commerce via a technical assistance agreement or an export license, or whether a license exemption/exception may apply. If prior approvals via licenses are necessary, discuss whether the license has been applied for or if not, the projected timing of the application and any implications for the schedule. Information regarding U.S. export regulations is available at http://www.pmdtc.org and http://www.bxa.doc.gov. Proposers are advised that under U.S. law and regulations, spacecraft and their specifically designed, modified, or configured systems, components, and parts are generally considered "Defense Articles" on the United States Munitions List and subject to the provisions of the International Traffic in Arms Regulations (ITAR), 22 CFR Parts 120-130.

(n) Cancellation of NRA.

(1) NASA reserves the right to make no awards under this NRA and to cancel this NRA. NASA assumes no liability for canceling the NRA or for anyone's failure to receive actual notice of cancellation.

(End of provision)

Appendix C

Required Proposal Cover Pages

Two steps are required to submit a cover page. The first step is to complete the proposal cover page (see SAMPLE on the next page) **electronically** to the SYS-EYFUS Website located at **http://proposals.hq.nasa.gov/**. If the proposer obtained a User ID and password in the process of submitting a proposal for a previous research opportunity announcement, the same user UserID and password can be used to complete the electronic proposal cover page in response to this research opportunity announcement. Be sure to click on "Edit Personal Information" if any of your correspondence information in SYS-EYFUS is not current.

The second step is to print a **hard copy** of the electronic cover page that must be signed by the Principal Investigator and an official by title of the investigator's organization who is authorized to commit the organization. This authorizing signature also certifies that the proposing institution has read and is in compliance with the required certifications printed in full, therefore, these certifications do not need to be submitted separately. This page will not be counted against the page limit of the proposal.

If you do not have a SYS-EYFUS UserID or password, you may obtain one electronically by going to **http://proposals.hq.nasa.gov** and performing the following steps:

3. Click the hyperlink for **new user** that will take you to the Personal Information Search Page.
4. Enter your first and last name. SYS-EYFUS will **search** for your record information in the SYS-EYFUS database.
5. Confirm your personal information by **choosing** the record displayed.
6. Select **continue**, and a User ID and password will be e-mailed to you.

Once you receive your User ID and Password, **login** to the SYS-EYFUS website and follow the instructions for **New Proposal Cover Page.**

Proposers without access to the web or who experience difficulty in using this site may contact the Help Desk at **proposals@hq.nasa.gov** (or call 202-479-9376) for assistance. After you have submitted your notice of intent or proposal cover page electronically, if you are unsure if it has been successfully submitted, **do not re-submit**. Please call the Help Desk. They will be able to promptly tell you if your submission has been received. Please note that submission of the electronic cover page does not satisfy the deadline for proposal submission.

Proposal Cover Page

Proposal Number: _____

Date: __/___/_____

Name of Submitting Institution: **Congressional District:**

Proposal Title:	
Name of Submitting Institution:	**Congressional Distinct:**

Certification of Compliance with Applicable Executive Orders and US Code

By submitting the proposal identified in this *Cover Sheet/Proposal Summary* in response to this Research Announcement, the Authorizing Official of the proposing institution (or the individual proposer if there is no proposing institution) as identified below:

- certifies that the statements made in this proposal are true and complete to the best of his/her knowledge;
- agrees to accept the obligations to comply with NASA award terms and conditions if an award is made as a result of this proposal; and
- confirms compliance with all provisions, rules, and stipulations set forth in the two Certifications contained in this NRA [namely, (i*) Assurance of Compliance with the NASA Regulations Pursuant to Nondiscrimination in Federally Assisted Programs, and (ii) Certifications, Disclosures, And Assurances Regarding Lobbying and Debarment & Suspension*].

Willful provision of false information in this proposal and/or its supporting documents, or in reports required under an ensuing award, is a criminal offense (U.S. Code, Title 18, Section 1001).

NASA PROCEDURE FOR HANDLING PROPOSALS

This proposal shall be used and disclosed for evaluation purposes only, and a copy of this Government notice shall be applied to any reproduction or abstract thereof. Any authorized restrictive notices that the submitter places on this proposal shall also be strictly complied with. Disclosure of this proposal for any reason outside the Government evaluation purposes shall be made only to the extent authorized by the Government.

Principal Investigator Name:		**Authorized Institutional Official Name:**	
Organization:		**Organization:**	
Department:		**Department:**	
Mailing Address:		**Mailing Address:**	
City, State Zip:		**City, State Zip:**	
Telephone Number:		**Telephone Number:**	
Fax Number:		**Fax Number:**	
Email Address:		**Email Address:**	
Principal Investigator Signature:	_____	**Authorized Institutional Official Signature:**	_____
Date:		**Date:**	

Co-Investigator:

Name	Telephone	Email	Institution	Address

Budget:

Year	**Budget**
1	

2	
3	
Total	

Assurance of Compliance with the NASA Regulations Pursuant to Nondiscrimination in Federally Assisted Programs

The *(Institution, corporation, firm, or other organization on whose behalf this assurance is signed, hereinafter called "Applicant ")* hereby agrees that it will comply with Title VI of the Civil Rights Act of 1964 (P.L. 88-352), Title IX of the Education Amendments of 1972 (20 U.S.C. 1680 et seq.), Section 504 of the Rehabilitation Act of 1973, as amended (29 U.S.C. 794), and the Age Discrimination Act of 1975 (42 U.S.C. 16101 et seq.), and all requirements imposed by or pursuant to the Regulation of the National Aeronautics and Space Administration (14 CFR Part 1250) (hereinafter called "NASA") issued pursuant to these laws, to the end that in accordance with these laws and regulations, no person in the United States shall, on the basis of race, color, national origin, sex, handicapped condition, or age be excluded from participation in, be denied the benefits of, or be otherwise subjected to discrimination under any program or activity for which the Applicant receives federal financial assistance from NASA; and hereby give assurance that it will immediately take any measure necessary to effectuate this agreement.

If any real property or structure thereon is provided or improved with the aid of federal financial assistance extended to the Applicant by NASA, this assurance shall obligate the Applicant, or in the case of any transfer of such property, any transferee, for the period during which the real property or structure is used for a purpose for which the federal financial assistance is extended or for another purpose involving the provision of similar services or benefits. If any personal property is so provided, this assurance shall obligate the Applicant for the period during which it retains ownership or posession of the property. In all other cases, this assurance shall obligate the Applicant for the period during which the federal financial assistance is extended to it by NASA.

This assurance is given in consideration of and for the purpose of obtaining any and all federal grants, loans, contracts, property, discounts, or other federal financial assistance extended after the date hereof to the Applicant by NASA, including installment payments after such date on account of applications for federal financial assistance which were approved before such date. The Applicant recognizes and agrees that such federal financial assistance will be extended in reliance on the representations and agreements made in this assurance, and that the United States shall have the right to seek judicial enforcement of this assurance. This assurance is binding on the Applicant, its successors, transferees, and assignees, and the person or persons whose signatures appear on the Proposal Cover Sheet above are authorized to sign on behalf of the Applicant.

CERTIFICATIONS, DISCLOSURES, AND ASSURANCES
REGARDING LOBBYING AND DEBARMENT & SUSPENSION

1. LOBBYING

As required by Section 1352, Title 31 of the U.S. Code, and implemented at 14 CFR Part 1271, as defined at 14 CFR Subparts 1271.110 and 1260.117, with each submission that initiates agency consideration of such applicant for award of a Federal contract, grant, or cooperative agreement exceeding $ 100,000, the applicant must **certify** that:

(1) No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned to any person for influencing or attempting to influence an officer or employee of an agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

(2) If any funds other than appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit a Standard Form-LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions.

(3) The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers (including subcontracts, subgrants, and contracts under grants, loans, and cooperative agreements) and that all subrecipients shall certify and disclose accordingly.

2. GOVERNMENTWIDE DEBARMENT AND SUSPENSION

As required by Executive Order 12549, and implemented at 14 CFR 1260.510, for prospective participants in primary covered transactions, as defined at 14 CFR Subparts 1265.510 and 1260.117—

(1) The prospective primary participant **certifies** to the best of its knowledge and belief, that it and its principals:

(a) Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded by any Federal department or agency;

(b) Have not within a three-year period preceding this proposal been convicted of or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State or local) transaction or contract under a public transaction; violation of Federal or State antitrust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property;

(c) Are not presently indicted for or otherwise criminally or civilly charged by a governmental entity (Federal, State or local) with commission of any of the offenses enumerated in paragraph (l)(b) of this certification; and

(d) Have not within a three-year period preceding this application/proposal had one or more public transactions (Federal, State or local) terminated for cause or default.

(2) Where the prospective primary participant is unable to certify to any of the statements in this certification, such prospective participant shall attach an explanation to this proposal.

Appendix D

BUDGET SUMMARY

For period from _____ to _____

- Provide a complete Budget Summary for year one and separate estimated for each subsequent year.
- Enter the proposed estimated costs in Column A (Columns B & C for NASA use only).
- Provide as attachments detailed computations of all estimates in each cost category with narratives as required to fully explain each proposed cost. See *Instructions For Budget Summary* on following page for details.

		NASA USE ONLY	
	A	**B**	**C**
1. Direct Labor (salaries, wages, and fringe benefits)	_____	_____	_____
2. Other Direct Costs:			
a. Subcontracts	_____	_____	_____
b. Consultants	_____	_____	_____
c. Equipment	_____	_____	_____
d. Supplies	_____	_____	_____
e. Travel	_____	_____	_____
f. Other	_____	_____	_____
3. Indirect Costs*	_____	_____	_____
4. Other Applicable Costs	_____	_____	_____
5. SUBTOTAL--Estimated Costs	_____	_____	_____
6. Less Proposed Cost Sharing (if any)	_____	_____	_____
7. Carryover Funds (if any)			
a. Anticipated amount : _____			
b. Amount used to reduce budget	_____	_____	_____
8. Total Estimated Costs	_____	_____	XXXXXXX
9. APPROVED BUDGET	XXXXXX	XXXXXXX	_____

***Facilities and Administrative Costs.**

INSTRUCTIONS FOR BUDGET SUMMARY

1. Direct Labor (salaries, wages, and fringe benefits): Attachments should list the number and titles of personnel, amounts of time to be devoted to the grant, and rates of pay.

2. Other Direct Costs:
    a. Subcontracts: Attachments should describe the work to be subcontracted, estimated amount, recipient (if known), and the reason for subcontracting.
    b. Consultants: Identify consultants to be used, why they are necessary, the time they will spend on the project, and rates of pay (not to exceed the equivalent of the daily rate for Level IV of the Executive Schedule, exclusive of expenses and indirect costs).
    c. Equipment: List separately. Explain the need for items costing more than $5,000. Describe basis for estimated cost. General purpose equipment is not allowable as a direct cost unless specifically approved by the NASA Grant Officer. Any equipment purchase requested to be made as a direct charge under this award must include the equipment description, how it will be used in the conduct of the basic research proposed and why it cannot be purchased with indirect funds.
    d. Supplies: Provide general categories of needed supplies, the method of acquisition, and the estimated cost.
    e. Travel: Describe the purpose of the proposed travel in relation to the grant and provide the basis of estimate, including information on destination and number of travelers where known.
    f. Other: Enter the total of direct costs not covered by 2a through 2e. Attach an itemized list explaining the need for each item and the basis for the estimate.

3. Indirect Costs*: Identify F&A cost rate(s) and base(s) as approved by the cognizant Federal agency, including the effective period of the rate. Provide the name, address, and telephone number of the Federal agency official having cognizance. If unapproved rates are used, explain why, and include the computational basis for the indirect expense pool and corresponding allocation base for each rate.

4. Other Applicable Costs: Enter total explaining the need for each item.

5. Subtotal-Estimated Costs: Enter the sum of items 1 through 4.

6. Less Proposed Cost Sharing (if any): Enter any amount proposed. If cost sharing is based on specific cost items, identify each item and amount in an attachment.

7. Carryover Funds (if any): Enter the dollar amount of any funds expected to be available for carryover from the prior budget period Identify how the funds will be used if they are not used to reduce the budget. NASA officials will decide whether to use all or part of the anticipated carryover to reduce the budget (not applicable to 2nd-year and subsequent-year budgets submitted for award of a multiple year award).

8. Total Estimated Costs: Enter the total after subtracting items 6 and 7b from item 5.

*** Facilities and Administrative (F&A) Costs**

APPENDIX E

Acronym List

AIRS	Atmospheric Infrared Sounder
AMSU	Advanced Microwave Sounding Unit
APS	Aerosol Polarimetry Sensor
Aqua	Name of EOS PM satellite
ATBD	Algorithm Theoretical Basis Document
ATMS	Advanced Technology Microwave Sounder
AVHRR	Advanced Very High Resolution Radiometer
CDR	Climate Data Record
CERES	Clouds and the Earth's Radiant Energy System
CrIS	Cross-track Infrared Sounder
DoD	Department of Defense
EDR	Environmental data Record
EOS	Earth Observing System
ESE	Earth Science Enterprise
GSFC	Goddard Space Flight Center
HIRS	High-resolution Infrared Spectrometer
HSB	Humidity Sensor Brazil
IASI	Interferometre Atmospherique de Sondage dans l'Infrarouge
IDPS	Interface Data Processing Segment
IPO	Integrated Program Office (of NPOESS)
LTA	Long-Term Archive
MODIS	Moderate-resolution Imaging Spectroradiometer
NASA	National Aeronautics and Space Administration
NOAA	National Oceanic and Atmospheric Administration
NPOESS	National Polar-orbiting Operational Environmental Satellite System
NPP	NPOESS Preparatory Project
NRA	NASA Research Announcement
OES	Office of Earth Science
OLS	Optical Line Scanner
OMB	Office of Management and Budget
OMPS	Ozone Mapping and Profiler Suite
SAGE III	Straospheric Aerosol and Gas Experiment III
SDS	Science Data Segment
SeaWIFS	Sea-viewing Wide Field-of-view Sensor
TDRSS	Tracking and Data Relay Satellite System
Terra	Name of EOS-AM satellite
UV	Ultraviolet (abbreviation)
VIIRS	Visible Infrared Imaging Radiometer Suite